STATUS AND POPULATION GENETICS OF THE ALABAMA SPIKE (ELLIPTIO ARCA) IN THE MOBILE RIVER BASIN

A Thesis
by
DANIEL HUNT MASON

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Abstract

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Declines in freshwater mussels (Bivalvia: Unionioda) are widely reported but rarely rigorously tested. Additionally, the population genetics of most species are virtually unknown, despite the importance of these data when assessing the conservation status of and recovery strategies for imperiled mussels. Freshwater mussel endemism is high in the Mobile River Basin (MRB) and many range-restricted taxa have been heavily impacted by riverine alterations, and many species are suspected to be declining in abundance, including the Alabama Spike (*Elliptio arca*). I compiled historical and current distributional data from all major MRB drainages to quantify the extent of declines in *E. arca* range based on naïve occupancy. I calculated change in area of occurrence (AOO) between 1987-2002 and 2003-2016 using 12 digit USGS HUCs as occurrence units. Concurrently, I used microsatellite markers to describe the population-level genetic characteristics of *E. arca* and identify differentiated lineages within the species. I did not detect a statistically significant change in the occupancy rates over the past 30 y. Calculations indicate that AOO increased by 5.6% from 1987-2002 to 2003-2016. My data provide no evidence to indicate that *E. arca* warrants elevated conservation status. However, genetic data show conflicting measures of diversity, and low rates of gene flow between drainages. Intraspecific genetic structure in *E. arca* is most significantly related to the geographic separation of the Tombigbee and Tallapoosa River Drainages, at both microsatellite and mitochondrial loci. Secondary structure is present among sites. My research shows that despite a lack of evidence for population declines or decrease in occupied area, detection is low for *E. arca* even with a species-specific study design, and that there are at least two divergent meta-populations within the species. These findings represent the first population genetic data for a Gulf Slope freshwater mussel and will help inform management decisions for this native and imperiled taxon.

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Foreword

The research resulting in this thesis will be submitted to *Conservation Genetics*, an international peer-reviewed journal; the body of this thesis has been formatted according to the style guide for that journal.

Introduction

Southeastern North America's freshwater ecosystems support a huge fraction of the continent's invertebrate and vertebrate biodiversity. However, many of its freshwater habitats have been subjected to extensive anthropogenic modification. The Mobile River Basin (MRB) is an ancient drainage system, dating from at least the Cretaceous period (Adams 1929; Conant 1964), but today it is one of the most fragmented drainages in the world (Pringle et al. 2000). The MRB and its fauna have been extensively altered by 30 large dams, thousands of low head dams (≤ 10 m high), extensive regions of canals and locks, and the Tennessee-Tombigbee Waterway, a 377 km barge canal linking the Tombigbee River and the Tennessee River drainages in northeastern Mississippi. These extreme habitat modifications fragment stream habitat and have been associated with dramatic changes to MRB freshwater mussel populations (Gangloff et al. 2015; Gangloff and Feminella 2007; Hamstead 2013; Hartfield and Jones 1990; Jones 1991; Mirarchi et al. 2004; Williams et al. 1992).

Numerous freshwater mussel taxa have been reported to be experiencing alarming rates of extinction and population declines in the southeastern US (Groombridge and Jenkins 1998; Lydeard and Mayden 1995) yet there are few widely applicable hypotheses about why these declines are occurring (Haag and Williams 2014). It is possible that mussel populations have become increasingly geographically and thus genetically isolated, predisposing them to the effects of genetic drift, inbreeding depression and localized extinction (Lesica and Allendorf 1995).

Geographic isolation

With the advancement of GIS and the increasing availability of open-access spatial data, analyses of the distribution of individuals or populations across a landscape are becoming powerful tools in conservation biology. The ability to use these data is crucial to studies of landscape genetics, which focuses on explaining the observed pattern of genotypes across an environment by using data describing the characteristics of the environment (e.g., habitat, climate, geology, dispersal barriers; Manel et al. 2003). Spatial data are also useful for simpler studies of population genetics, as they can impart greater significance to the conclusions made from genetic analyses.

For close to 100 y, the MRB has been fragmented by large dams (Williams et al. 2008). Although the construction of large dams has slowed in the past three decades, large scale hydrologic alteration of the MRB continued into the 1980s (e.g., the Tennessee-Tombigbee Waterway). As habitat fragmentation increases, populations become smaller, more isolated and presumably have reduced genetic connectivity (Hanski 1998; Kindlmann and Burel 2008). Identifying the effects of dispersal can be difficult and requires examinations across multiple populations. In particular, impoundments significantly fragment freshwater habitats, often with negative effects on aquatic organisms (Fluker et al. 2014; Neves et al. 1997; Pringle et al. 2000). Genetic data can be utilized to answer questions about population connectivity or, conversely, the degree of isolation (Leis 2002; Palumbi 2003). Reduced genetic diversity is often associated with reduced intra-specific and intra-population genetic variation, effects on fitness and population persistence in changing environments (Reed and Frankham 2003). These risks have been noted in populations of freshwater mussels, due to both geographic isolation and small size (Berg et al. 2007; Stoeckle et al. 2017).

Genetic (reproductive) isolation

Population biologists define populations as groups of individuals of the same species that are reproducing, but populations themselves can interact as members of metapopulations (populations of populations; reviewed in Hanski and Gilpin 1991). Each metapopulation is composed of populations that are able to interact with each other through the dispersal of individuals (Hanski and Gilpin 1991) but are not sufficiently connected to constitute a single continuous population. The nature of these interactions is dynamic and is influenced by environmental factors, which in turn are influenced by humans.

Dispersing individuals contribute to gene flow among populations by physically moving their genotype across the landscape and subsequently introducing it into a different population through reproduction (Bilton et al. 2001). Gametes may also disperse across a landscape, but inter-population dispersal of freshwater mussel gametes probably does not contribute to gene flow as much as dispersal of glochidial larvae on host fishes (Berg et al. 2007; but see Ferguson et al. 2013). When gene flow is minimal, the effects of genetic drift become more pronounced and lead to decreased heterozygosity and eventually loss of rare alleles. Decreased heterozygosity (and increased inbreeding) increases the probability of population extinctions (Reed and Frankham 2003). When geographic isolation is sufficient to also genetically isolate or fragment populations, the effects of genetic drift can contribute to the decline of an entire species, especially in range-restricted species like *E. arca* that now only occur in isolated patches of free-flowing streams in the MRB (Williams et al. 2008).

Study Species

The Alabama spike, *Elliptio arca* Conrad, 1834, described from a specimen collected in the Alabama River, is endemic to the Gulf Coast of North America and historically occurred in the MRB in Georgia, Mississippi, Tennessee and Alabama as well as the Pearl and Pascagoula drainages in Mississippi (Williams et al. 2008). *Elliptio arca* is currently being considered for protection under the Endangered Species Act (CBD 2010). Currently it is believed that 12 geographically-disjunct populations of *E. arca* remain, and only 2-3 are believed to be stable and reproductively viable (Williams et al. 2008). The Buttahatchee and Sipsey rivers have been well-surveyed and large populations remain in these systems (McCullagh et al. 2002). Small populations have also been recently documented from several other Tombigbee streams but it is no longer frequently encountered in the mainstem river (Hamstead 2013; McGregor and Garner 2001; 2002; 2003, Table 2). Recent data also suggest that *E. arca* is widespread in the Tallapoosa Drainage but surveys of other MRB streams suggest that populations are nearly extirpated from the Black Warrior and Cahaba drainages (McGregor et al. 2013; McGregor and Garner 2004, 2005; McGregor and Wynn 2008). Very small and highly localized populations persist in several Coosa Drainage tributaries in Alabama and Georgia (Dinkins and Hughes 2001; Gangloff and Feminella 2007; McGregor and Garner 2004; Williams and Hughes 1997). Collections from the early 20th century suggest that *E. arca* was once frequently encountered in the large mussel beds that characterized the shoal habitats of the Coosa and Tombigbee Rivers (Williams et al. 2008), but the impoundment of essentially all of these shoals by locks and dams has likely wiped out many of these populations and their habitats. Due to these and other factors, *E. arca* is a S2

(Imperiled) species in the state of Alabama. However, it is not a federally listed species and has been deemed Data Deficient by the International Union for Conservation of Nature (IUCN) (Bogan 2000).

Elliptio arca is a species in need of conservation re-assessment, that seems to be alarmingly rare throughout much of its historical range and that also has very little data describing its genetic diversity or structure. The objectives of my research are (1) to re-survey the historically occupied sites in the MRB to determine the current species' distribution and statistically evaluate spatio-temporal trends in site occupancy, and 2) examine genetic diversity within and among E. arca populations to determine the degree to which habitat fragmentation and geographic isolation have influenced population connectivity. Using a combination of spatial, genetic and traditional survey methods, I will provide a scientific assessment crucial to conservation of *E. arca* in the MRB.

Methods

Field methods

In the summer/fall of 2016, I conducted mussel surveys at 74 sites in the MRB that were historically occupied by *E. arca* or were in systems with historical records using snorkeling/SCUBA using visual/tactile sampling methods. Surveys targeted run and riffle mesohabitats most frequently occupied by *E. arca* (Williams et al. 2008) and I recorded the abundance of all mussels encountered. I calculated a catch per unit effort (CPUE = # of individuals/person-minutes spent searching) for *E. arca* at each site and used a laser rangefinder to quantify the area of habitat covered by the survey crew during the search to provide an estimate of density. Where *E. arca* occurred in relatively high abundance (>6 individuals per hour of searching) and where state regulations allowed, I vouchered whole specimens and preserved them in 95% non-denatured ethanol. These specimens will be deposited in public museum collections (e.g., MS Museum of Natural Science, Auburn University Museum and Appalachian State University Zoological Collections).

I removed a sample of adductor muscle from each vouchered individual and placed it in a vial of 95% non-denatured ethanol, stored at -80ºC. I collected non-lethal DNA samples using buccal swabs (Isohelix SK-1 swabs, Boca Scientific Inc., Boca Raton, FL) by gently prying open mussels to a width of ~5mm and swabbing each side of the foot 8-12x, using a different side of the swab for each side of the foot (modified from Henley et al. 2006).

Spatial analyses

I used ArcMap 10.3 (ESRI, Redlands, CA) to create maps of georeferenced survey locations for *E. arca* occurrence records in the MRB from 1987-2016 (Table 2). I calculated generation time using the IUCN Generation Length tool (http://www.iucnredlist.org/technical-documents/red-list-training/red-list-guidance-docs) and data describing lifespan and fecundity (Haag and Rypel 2011; Haag and Staton 2003). Based on a three-generation time of 15 y for this taxon I assumed records from 2003-2016 represent the most recent three generations of this species (i.e., current records) whereas records from 1987-2002 represent the previous three generations (i.e., past records). The IUCN recommends that assessments be performed over a 3 generation time span, but due to the lack of even spatio-temporal coverage in survey records, I conducted my assessment over the past 6 generations. Museum records, agency databases, agency reports, data provided by colleagues and unpublished data were used to create zero-filled data matrices, by assuming that any surveys or collection localities in the MRB that reported a mussel taxon, but did not report *E. arca* represented non-detections. Only records with a locality given in latitude/longitude and with a collection year were included in analyses or maps, yielding a final dataset of 1,862 records.

The IUCN Red List guidelines consist of 5 criteria (A-E) that can be used to classify the status of a species in to one of 9 categories (Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable, Near Threatened, Least Concern, Data Deficient, Not Evaluated). Broadly, the 5 criteria address evidence for declining or small populations, fragmented or limited geographic ranges and quantitative analysis of extinction risk (PVA) to assign a species to a category. A species can be elevated to a higher threat category based on any of the 5 criteria, but does not need to be assessed at all criteria for evaluation. In the case of conflicts among criteria, the highest category is assigned, as a precautionary measure.

For each time period (past and current) I mapped mussel survey and *E. arca* detections in the MRB as well as the results of my 2016 surveys. Occurrence records for *E. arca* were spatially represented at the 12 digit USGS HUC (Hydrologic unit codes) level; all HUCs with occurrence records were considered occupied. Occupancy calculations did not account for multiple records within a HUC or for both absence and presence records in the same HUC. Computing occupancy rates in this manner is conservative because large populations and small populations are equally weighted. These occurrence data are relevant for assigning a threat category using the IUCN Criterion A: population decline.

The HUC approach is preferred when mapping distributions of aquatic taxa (e.g. mapping standards for IUCN Red List Assessments) and can also be used to calculate a species' area of occupancy (AOO). I summed the area within all detected HUCs and then calculated the percent change in AOO between the past and current datasets. This calculation is relevant to assigning a threat category using the IUCN Criterion B: decline in geographic range size.

Using the PoPS R script (Jay et al. 2012), I mapped the *Q*-matrix results from the final STRUCTURE output to a geographic map of the study area, using a kriging method in RStudio v1.0.143 (RStudio Team 2016).

Naïve occupancy methods

Using the occurrence data, I tested the null hypothesis that there had been no change in naïve occupancy of *E. arca* between the past and current three generation periods. Naïve occupancy is simply the ratio of locations where a species was detected to the number of sites at which a survey was conducted. I used the occurrence data to designate a fixed subset of locations consisting of 76 of the 1275 12-digit HUCs in the MRB. Although this subset does not represent every HUC from which *E. arca* has been reported in the MRB, HUCs are evenly spaced among sub-drainages and were sampled during both the past and current periods. Following the approach outlined in Ewing and Gangloff (2016), I used a McNemar test in SPSS (IBM, 2015) to test this hypothesis, and evaluated post hoc power using a web application (www.statstodo.com/SSizMcNemar_Pgm.php).

Genetic methods

I extracted whole genomic DNA using MoBio UltraClean® Tissue and Cells DNA Isolation Kits (MoBio Laboratories, Carlsbad, CA) following manufacturer protocols, including the optional Proteinase K step. I measured DNA concentration and purity with a NanoDrop 1000 nano-spectrophotometer (Thermo Scientific, Waltham, MA) and by gel electrophoresis of extracted DNA (5 µl DNA solution, 1% agarose gel, run at 100 V for 60 min). To produce data for investigating population structure, genetic drift and inbreeding depression, I amplified 12 microsatellite regions within the nuclear genome using primers developed for *Elliptio complanata* (Ward et al. 2010). Microsatellite PCR reactions consisted of 10 µl reactions using GoTaq® green Master Mix (Promega Corporation, Madison, WI, Catalog #: M5122), 1 µl of template DNA (15-35ng/µl), 0.5 µl (10 µM) of both forward and M13 primers (M13 motif added to the forward sequencing primer), 1.0 µl (10 µM) of reverse primer. I amplified microsatellite loci using a touchdown PCR protocol in an Eppendorf Mastercycler® (Enfield, CT, USA) nexus thermal cycler with conditions as follows; 94 ºC for 2:00, then 13 cycles of 94 ºC for 0:45, 68-55 ºC dropping 1 ºC per cycle for 2:00, 72 ºC for 1:30 followed by 25 cycles of 94 ºC for 0:45, 53 ºC for 1:00, 72 ºC for 1:00 and final extension at 72 ºC for 10:00 before holding at 10 ºC. PCR products were pseudo-multiplexed in Hi-Di with GeneScan™ LIZ 500 (Invitrogen) size standard and sent to the University of Georgia Genomics Facility for genotyping on an ABI (Applied Biosystems) 3730 XL Capillary Sequencer.

To investigate the evolutionary history of *E. arca* across its distribution, I amplified a fragment of the cytochrome oxidase subunit 1 (*COI*) mitochondrial gene using primers developed by Campbell and Lydeard (2012);

(forward 5’ -GTTCCACAAATCATAAGGATATTGG - 3’;

reverse 5’ -TACACCTCAGGGTGACCAAAAAACCA - 3’).

COI PCR reactions consisted of 15 µl reactions using 7.5 µl of GoTaq® green Master Mix 2X (Promega Corporation, Madison, WI), 1.14 µl (15-35 ng) of template DNA and 0.28 µl (10 µM) of both forward and reverse primers. For amplification of *COI*, touchdown PCR conditions were as follows: 94ºC for 5:00, then 13 cycles of 94 ºC for 0:45, 57-44 ºC for 2:00, 72 ºC for 1:00, then 25 cycles of 94 ºC for 0:45, 55 ºC for 1:00, 72 ºC 1:00, before final extension at 72 ºC for 10:00 and hold at 10 ºC. *COI* PCR products were examined visually via gel electrophoresis on a 1% agarose gel stained with ethidium bromide, then purified with ExoSAP and sequenced off-site by Retrogen Inc. (San Diego, CA) with an ABI 3730 XL DNA Analyzer and ABI Big Dye Terminator Kits (Life Technologies, Grand Island, NY).

The microsatellite dataset was scored using the Geneious 7.0.6 software package (Kearse et al. 2012) and checked for evidence of null alleles, stutter peaks, and large allele drop out using MICRO-CHECKER v2.2.3 (van Oosterhout et al. 2004), with 1000 randomizations and 95% confidence intervals**.** I used exact tests with a Markov chain algorithm with 1000 dememorizations, 100 batches and 1000 iterations per batch in the program GENEPOP 4.2 (Raymond and Rousset 1995; Rousset 2008) to test for deviations from Hardy-Weinberg equilibrium (HWE). I tested for linkage disequilibrium across all pairs of loci using 1000 dememorizations, 100 batches and 1000 iterations per batch in GENEPOP. I also used FSTAT v2.9.3.2 (Goudet 2001) to calculate allelic richness (AR), observed heterozygosity (H_o), expected heterozygosity (H_e), and private alleles (PA). Using the program STRUCTURE **(**Pritchard et al. 2000), I determined the number of distinct populations represented in my microsatellite dataset and assigned each individual to its population. STRUCTURE analyses used a model allowing admixture of populations, with correlated allele frequencies, 100,000 burn-in and 300,000 iterations after burn-in, replicated

3 times for each value of K. Mean LnPD and ΔK for each value of K (1-9) was assessed using the Structure Harvester web application (Earl and vonHoldt 2012). The final STRUCTURE outputs for the best estimate of K were summarized in CLUMPP (Jakobsson and Rosenberg 2007) using the default settings and then visualized in DISTRUCT (Rosenberg 2004). Using AMOVA in Arlequin v3.5.2.2 (Excoffier and Lischer 2010), I investigated the partitioning of genetic variation among individuals, sampling sites, and the entire MRB and calculated F statistics for each comparison. In order to test for genetic isolation by distance, I used Mantel tests (Mantel 1967) in GenAlEx v6.5 (Peakall and Smouse 2012), with 9999 permutations to compare genetic distance values with geographic distance between sampling sites (measured in stream km using Google Earth 7.1.1.1580, Google 2013). To test for an excess in H_e that could indicate recent declines in effective population size (N_e), I used the program BOTTLENECK (Cornuet and Luikart 1996), and assessed deviations of H_e from H_{eq} using Wilcoxon signed-rank tests with 10000 replicates and a two-phase model, where 95% of mutations were single-step and a 12% variance of multi-step mutations (Piry et al. 1999).

COI sequence reads were compiled, edited and aligned using CLUSTALW (Larkin et al. 2007) in the Geneious 7.0.6 software package. Samples represented by *COI* sequences with < 96% quality bases were discarded, as were sequence reads shorter than 500 nucleotides. Sequences were additionally examined for stop codons, mitochondrially-derived nuclear DNA fragments (numts) and male mitotypes as suggested by Buhay (2009). Using PopArt (Leigh and Bryant 2015) I constructed TCS haplotype networks (Clement et al. 2002), to further examine the genetic relationships within *E. arca*. Haplotype patterns were examined by defining traits as the stream from which the individual was collected.

Results

Field results

I collected *E. arca* from 21 of 74 sites in 2016, an occupancy rate of 28.4% (Table 1). These sites covered 47 unique 12-digit HUCs, 16 of which (34.04%) contained at least one site where the target species was encountered in my surveys. In total, I detected 164 *E. arca*, with an average catch per unit effort (CPUE) of 1.01 individuals/person hour. Since each site had a variable amount of suitable habitat for the target species, sampling effort and search area were variable across sites. Sampling effort averaged 2.54 person hours and ranged from 0.5-8.55 person hours while search area averaged 971.73 m^2 and ranged from 95-3423 m^2. The total lengths of captured *E. arca* individuals averaged 67.01 mm and ranged from 28.5 to 92.8 mm.

Naïve occupancy and spatial results

During the 'past' (1987-2002) three generation period *E. arca* was detected in 28 of 76 HUCs for a naïve occupancy ratio equal to 36.8%. During the current (2003-2016) three-generation period *E. arca* was detected in 26 of 76 HUCs for a naïve occupancy ratio equal to 34.2%. *Elliptio arca* was not detected from 11 HUCs where it had been collected in the past. However during 2003-2016 it was also detected from 9 HUCs where it had not been detected during 1987-2002. McNemar's test did not indicate any significant change in the frequencies of detection between the past and the current datasets (N= 76 HUCs, df=1, p=0.824) and post hoc power was extremely low (1-β=0.0649), indicating that far more samples would be needed to reliably detect very small changes in occupancy (<3%) using this method. However, at this sample size, the test had ample power to detect a 30% change in frequency had it been observed in the data (1-β=0.9726 for a 30% difference in occurrence frequency). A 30% population reduction constitutes evidence to list a taxon as vulnerable under IUCN criteria (IUCN 2014). When occurrence data were pooled at the 10 digit HUC scale, analysis also suggested that there has been no significant change in occupancy. Calculations in ArcMap comparing 32 repeatedly sampled and historically occupied HUCs showed that there was a 5.6% difference in area of occurrence (AOO) estimates computed using the past (2551.1 km^2) and the current (2694.2 km^2) datasets.

Genetic results

All five microsatellite loci were polymorphic and amplified reliably across all populations (Eco 1, Eco 2, Eco 21, Eco 23, Eco 29). Any individuals with >20% missing data were discarded from the analysis (n=88). Several sites had <5 individuals represented, data from these sites was not included in the final dataset. The final dataset represents individuals from eight different locations (Table 3). Individuals collected from multiple sampling sites in Sandy Creek (Tallapoosa Drainage) and the Buttahatchee River (Tombigbee Drainage) were grouped into one location for analysis due to the close proximity of the sampling points (<400 m). Analysis using Microchecker did not indicate any evidence of null alleles, scoring errors or large allele dropout in the data, and tests for linkage disequilibrium were also not significant. The results of exact tests for Hardy-Weinberg proportions were not significant across all loci/population combinations except one (Eco 1, Sipsey River site 6), which demonstrated an excess of observed heterozygosity (Table 4). However, this population is represented by only 7 individuals in my dataset and has very few alleles (3) at Eco 1, indicating that the observed deviation from expected allele frequencies is most likely due to sampling effects, not false data. Therefore, despite the significant result from the exact test (χ^2=6.178, df=6, p=0.032), this locus was not removed from the analysis. Additional support for this decision was provided by analysis of the allele frequency distributions in Microchecker. No loci deviated from Hardy-Weinberg expectations when samples were pooled.

When data were pooled by collection site, number of alleles averaged 4.15 (3.2-5.4) across all loci, AR averaged 3.38 (2.9-3.59) across all loci, PA averaged 5.25 (0-7) across loci, H_o averaged 0.486 (0.400-0.593) across loci and H_e averaged 0.457 (0.369-0.525, Table 5). Sites in the Tallapoosa Drainage had higher numbers of private alleles (mean=5.33, range 4-7) than sites in the Tombigbee Drainage (mean=1.6, range 0-3) although all Tallapoosa Drainage sampling sites were in different streams and the 5 Tombigbee Drainage sites were distributed in only 2 streams. Only one of eight sites (Tallapoosa River site 1) showed lower than expected heterozygosity, the rest demonstrated observed heterozygosity that conformed to Hardy-Weinberg proportions (Table 5). Comparisons of F_{st} values among sampling sites are summarized in Table 6. All sites were significantly different from each other (mean p=0.0112, range=0.00001-0.287) except for Sipsey River site 5 and Sipsey River site 6 (p=0.287). There were no statistically significant differences in AR, H_o, F_{IS}, or F_{ST} between drainages.

The Δk values from STRUCTURE analysis of all sites indicated that K=2 is the most likely clustering scenario within the data (Figure 4). However, plots of mean LnPD plateaued at K=3, and then declined. Labeling the sampling sites on the x-axis of the bar plot revealed that the K=2 groupings correspond to the geographic drainage from which the survey site was located and that K=3 resulted in two clusters by stream in the Tombigbee Drainage. In this scenario, reliance on LnPD can lead to overestimated K values (Evanno et al. 2005), therefore I tested for substructure within drainages in separate analyses, with the same parameters as before. The independent results of both ΔK and LnPD suggest K=2 for samples from the Tallapoosa Drainage, made of one cluster from the Tallapoosa River and one cluster from Sandy and Little Sandy Creeks, and K=2 for the Tombigbee Drainage samples, made of one cluster from the Buttahatchee River and one from the Sipsey River (Figures 6 and 7). However, in the combined analysis, there was no observed structuring in populations from the Tallapoosa Drainage at K=2-6. Because ΔK was very low (1.313) for K=2 and LnPD may overestimate K, I consider K=1 to be most likely scenario for samples from the Tallapoosa Drainage. Investigation of barplots revealed that in the Tallapoosa Drainage, there were symmetric proportions of assignment for all sites at all K values, confirming K=1 (Figure 7). Therefore, across the entire dataset, K=3 (Figure 5).

AMOVA with microsatellite data indicated that there was significant structuring between drainages (df=1, $p<0.0001$) that explained 42.5% of the variation, as well as structuring among sites within drainages (df=6, $p>0.0001$). However, among-site variance only explained 4.5% of the variation in the data. The remaining variation was explained by differences among individuals within sampling sites (50%).

The Mantel Test results indicate that there was a significant relationship between genetic distance and geographic distance (stream km) between sampling sites (R^2= 0.8404, p=0.0001, df=87). To confirm that this relationship is due to a stepping stone model of evolution, and not just to divergence between drainages, I split the data by drainage and re-ran the Mantel test. Results from independent analyses of both drainages were still significant, although the strength of the relationship decreased substantially (Tombigbee Drainage; $p=0.0001$, $R^2=0.181$, $n=58$, Tallapoosa Drainage; $p=0.021$, $R^2=0.029$, $n=30$).

H_e excess tests in BOTTLENECK indicated that under a two-phase model, there was significant evidence for an excess in H_e, indicating recent reductions in N_e for two populations, Tallapoosa River site 1 ($n=8$, $p=0.0312$) and Sipsey River site 5 ($n=5$, $p=0.0312$).

I generated 61 mtDNA sequences from individuals collected in 2016, and included 3 sequences from GenBank, for a total of 64 individuals in the final *COI* alignment. The total length of the alignment was 510 bp, with no gaps, and contained only one individual with a non-synonymous mutation. From this alignment, I obtained 10 different *COI* haplotypes ($\pi=0.0128$), 5 of which were shared by multiple individuals. Intraspecific pairwise genetic difference was moderate (0-3.9%).

The TCS haplotype network shows two major clusters of haplotypes separated by 20 steps, with one cluster composed entirely of individuals from the Buttahatchee and Sipsey rivers, and another cluster defined mostly by individuals from the Tallapoosa River, with additional individuals from Roberts and Sandy creeks and the Buttahatchee River (Figure 9). Along the branch connecting these two clusters, 3 individuals from Coosa Drainage streams are represented by two haplotypes, each corresponding to a different stream (Figure 9). Overall, the haplotype network demonstrates some ancestral geographic structure, but also indicates haplotype sharing among *E. arca* populations in different MRB drainages. The haplotype network did not distinguish between the Buttahatchee and Sipsey rivers with as much clarity as was present in the STRUCTURE output.

Discussion

Using genetic data to inform the management of at-risk species is an important approach that can be used to identify management units and assess long-term viability of populations. In this study, I examine single-season and long-term distributional trends and genetic data to assess the conservation status of *E. arca* in the MRB. This question has been addressed by past authors (Williams et al. 1993), but has recently resurfaced (CBD 2010). In addition to ongoing evaluation at the federal level, the current status of this species is undetermined under IUCN criteria (Bogan 2000).

The MRB is noted for its high degree of hydrologic alteration and the subsequent declines of its native freshwater fauna, especially mollusks (Gangloff et al. 2015; Gangloff and Feminella 2007; Hamstead 2013; Hartfield and Jones 1990; Jones 1991; Mirarchi et al. 2004; Williams et al. 1992). Although quantification or isolation of specific factors that are influencing the occurrence or genetic characteristics of *E. arca* was beyond the scope of this study the data presented here are an important first step towards integrating occupancy and genetic data into conservation planning for this species.

My work concentrates the available occurrence data for this species in to a dataset that covers the past 30 y, and statistically assesses frequency of occurrence using a naïve occupancy approach. Although changes to freshwater mussel distributions are frequently discussed in the literature, few studies have used statistical approaches to examine these changes (but see Hart et al. 2004; Lee and DeAngelis 1997; Morales et al. 2006). My study provides a quantitative, repeatable approach that can serve as a model for examining changes to the distribution of other at-risk taxa.

Allelic richness (AR=3.38) in *E. arca* is limited, is largely partitioned between two geographically disjunct drainages and there appears to be little evidence for contemporary genetic linkages (Fst = 0.474). However, diversity measured as H_o was not lower than H_e at any sampling sites. The combined results from AMOVA and STRUCTURE indicated lower (mean Fst =0.163, K=1) but significant structure among samples from different sites in both drainages and high amounts of structure between the Buttahatchee and Sipsey Rivers, two Tombigbee tributaries (mean Fst = 0.171, K=2). In contrast, a study of Atlantic Slope *Elliptio spp.*, found a general lack of genetic structure at the same microsatellite loci among several species from the Altamaha River (Small et al. 2012). The mtDNA data demonstrate a shared ancestry among individuals from different sub-drainages in the MRB, but are largely congruent with the recognition of different lineages within *E. arca* that correspond to the Tombigbee and Tallapoosa Drainages. The few individuals from the Coosa Drainage for which I produced mtDNA data appear to have intermediate genotypes that are located between haplotype clusters of the Tombigbee and Tallapoosa drainages. My study describes the genetic structure of a rare mollusk species at both nuclear and mitochondrial loci, which may be useful to consider in future decisions regarding management of *E. arca* populations at both the state and federal levels. Additionally, it provides the first data describing the population genetics of a Gulf Slope *Elliptio* taxon and opens the door for more finely resolved comparisons of species and population boundaries within the genus.

2016 survey results and occurrence trends

The data from my 2016 targeted survey approach suggest that detection probability for *E. arca* is low during qualitative snorkel surveys, as it required significant effort to gather moderate sample sizes, even in streams where it is known to occur in relatively high abundance (Table 1). Individuals were often buried deeply (~10 cm) in lowland gravel-dominated channels in the Buttahatchee and Sipsey rivers or were found underneath rock slabs in Piedmont streams including Terrapin Creek. Despite low rates of detection, only 4 other species were encountered more frequently per unit effort (Table 5). This is most likely because of my species-specific study design, as all 4 of these species are widespread in the MRB. Measurements of total length additionally suggest that my samples from streams in the Tombigbee River Basin were mostly composed of older age classes, although populations from these streams are known to be undergoing juvenile recruitment (Gangloff et al. 2015; Haag and Warren 2003). By the fall of 2016, much of the MRB was in severe or extreme drought conditions (NOAA 2016) leading to low flows in most streams and dry stream-beds in tributaries. While low flows potentially increased my search efficiency for most of the season, they may have also influenced mussel behavior, possibly influencing detection probability in an unpredictable manner.

A series of other workers have noted that the extensive impoundment and canalization of the MRB's large rivers have negatively influenced its freshwater fauna (Fluker et al. 2014; Hamstead 2013; Hartfield and Jones 1990; Jones 1990; Williams et al. 1992). In the past 15 y, *E. arca* has only been detected at 9 HUCs on a mainstem river, and within the past 10 y, at only 3 HUCs (Table 2). Other survey work has shown that it is very uncommon in the mainstem Tombigbee and Cahaba Rivers, isolated in tailwater reaches of the Coosa River, and potentially extirpated from the Black Warrior River (McGregor et al. 2004; McGregor et al. 2005; McGregor et al. 2013; Williams et al. 1992; Figures 1 and 2). Historically, the shoals of these rivers, especially the Coosa and Tombigbee Rivers, supported an abundant and diverse mussel fauna (Hurd 1974; Hinkley 1906), which may have functioned as source populations for tributary populations. The decline or extirpation of these populations over the past ~100 y may have greatly reduced gene flow among tributaries, and almost certainly has left the tributary populations more susceptible to the effects of genetic drift.

Naïve occupancy and AOO

My results show no change in the frequency of occurrence of *E. arca* in the MRB between two three generation periods and therefore no evidence for increased threat level under IUCN Criterion A (IUCN 2014). However, the McNemar test, even with a fixed re-sampling design, requires large sample sizes to attain the power necessary to resolve small differences in occurrence frequency (also see Ewing and Gangloff 2016; Strayer 1999). It is also important to mention that from 2003-2016, results of my targeted surveys and other studies (813 surveys total) did not completely re-survey the known historical occurrences of *E. arca* (10 HUCs were not re-sampled), which potentially impacted my ability to detect changes in occupancy. Another limitation of the naïve occupancy approach is that substantial effort is often required to attain sufficient sample sizes for taxa with fragmented or large ranges. However, naïve occupancy designs are compatible with the qualitative survey approaches often employed by natural resource agencies and contract surveys and are thus are better able to include records from many different study designs. This approach also has the benefit of using statistical inference to determine whether observed changes in occupancy could have been detected by chance. Additionally, naive occupancy approaches are compatible with most conservation status rubrics including the IUCN's widely-used metrics (IUCN 2014).

In contrast to the naïve occupancy approach, I could only calculate the raw difference in AOO of *E. arca* between the two periods, resulting in an observed 5.6% increase in AOO. I primarily calculated this difference to compare it to the IUCNs guidelines for Criterion B; assessing conservation status using changes in AOO (IUCN 2014). Under this criterion, my data do not indicate that *E. arca* merits an elevated threat category.

Genetic diversity

Seven of twelve Ward et al. (2010) microsatellite loci failed to amplify reliably, likely due to genetic divergence between *E. arca* and the Atlantic Slope *E. complanata* specimens used to develop the markers. I also noted that there was a notable degree of genotyping failure (~10%) for specimens that presented a PCR product band during gel electrophoresis. The rate of failure was slightly variable among loci, but did not vary among genotyping dyes, and seems to have been most common in DNA samples with low 260/230 ratios (<1.6). This pattern of failure reduced genetic sample sizes for several of the sites included in this study, and eliminated two sites that potentially could have been included (Roberts and Terrapin creeks).

I observed different patterns of genetic diversity between AR and H_o, with low diversity as measured by AR, and no deviations from expected heterozygosity at most sites. This may be because in small populations, AR is a more accurate estimator of diversity than heterozygosity, as measures of heterozygosity respond more slowly to reductions in population size than AR (Allendorf et al. 2013). However, most of my sites have low sample sizes (N<15), which negatively impacts the probability of detecting any given allele, potentially underestimating diversity. Mean AR was low at all sites, regardless of stream or drainage, and did not significantly differ between drainages. H_o indicated higher diversity (mean=0.498) than AR at all sites. Low AR was observed even with higher sample sizes and also in the Sipsey River, a protected stream with an intact floodplain that supports a large *E. arca* population. Because I did not find statistical evidence for changes in occupancy over the past 30 y, it is possible that low AR is related to founder effects in headwaters and tributaries, not due to range-wide reduction in N_e. Unfortunately, there are no known extant mainstem populations that could provide data to test this hypothesis. AR could also be demonstrating founder effects in tributaries that H_o is not sensitive enough to detect, although considerations should be made for the differential effects of sample size on these two metrics. There was significant evidence of recent bottleneck events in two samples, Tallapoosa River site 1 and Sipsey River site 5, although sample sizes were low for both sampling sites. Therefore, I consider these results to be suggestive of bottleneck events, but in need of further investigation to verify their significance.

Genetic structure

The difficulty I encountered attempting to locate populations of this species prevented me from testing explicit hypotheses regarding the factors influencing its genetic structure. However, important conclusions can still be made based on descriptive analyses. The results from AMOVA and STRUCTURE analyses support the distinction of two differentiated groups between the Tombigbee and Tallapoosa Drainages. AMOVA also suggests significant structuring among nearly all sampling sites within drainages, although STRUCTURE only recognized clustering between sampling streams in the Tombigbee Drainage and no clustering was detected among Tallapoosa Drainage streams. This could be due to the lack of multiple sampling sites within streams in the Tallapoosa Drainage, or to significant recent gene flow within the drainage. Significant but low differences in F_{ST} among sites in the Tallapoosa Drainage suggest that populations in these streams are diverging, but have begun to do so only recently (Table 6). The mtDNA data are consistent with this interpretation, as there was no discernable geographic structure to haplotypes within the Tallapoosa Drainage. Extensive fragmentation of the Tallapoosa River mainstem by large dams and their impoundments makes high rates of gene flow unlikely in the future and other studies suggest that these impoundments have fragmented populations of host species as well (Fluker et al. 2013).

Conservation implications

My study shows that there is no statistically discernable change in the occurrence of *E. arca* over the past six generations of this species. This is an important finding because the USFWS is considering E. arca for listing under the endangered species act (CBD 2010). However, it also demonstrates that even with a targeted study design, detection probability (and thus naïve occupancy) for this species is low. Additionally, at sites where *E. arca* was detected I only rarely encountered it at a rate >6 individuals per person hour (2/21 sites). This, combined with low allelic richness observed at all sites, validates the conservation concern expressed by authors in the past (Mirarchi et al. 2004; Williams et al. 1993). Importantly, most of the structuring among populations of *E. arca* appears to be related to ancestral lineage sorting between major sub-drainages, with moderate differentiation among sites in the same watershed. This is in contrast to the conclusions from an unpublished report (Campbell and Harris 2006) that describes no genetic variation within *E. arca* in the MRB. Campbell and Harris (2006) also suggest that there is evidence for an additional species of *Elliptio* in the Tallapoosa system, referencing a specimen collected from Loblockee Creek which they suggested could be *Elliptio purpurela*. This suggestion is not supported by the specimens I collected in the Tallapoosa Drainage, or by my genetic data, although I did not conduct a survey in the same stream.

I observed a pattern of lineage differentiation that has not been frequently observed in other *Elliptio* taxa, the majority of which occur in Atlantic Slope drainages and exhibit limited genetic structure among populations or species. However, there is only one other published study of *Elliptio* that uses microsatellite markers (Small et al. 2012). Analyses of microsatellites in other mussel taxa commonly report genetic structuring that corresponds with watershed boundaries (Ferguson et al. 2013; Galbraith et al. 2015; Mock et al. 2010; Zanatta and Murphy 2008). Genetic structure observed among *E. arca* populations may be related to adaptive radiation within the species, genetic drift, the geomorphology of the basin, or a combination of these and other factors. My data suggest that lineages in different drainages should each be considered separate management units.

My study provides data describing the contemporary and ancestral genetic structure of a rare mollusk species, which can be used to inform decisions regarding future management and listing decisions at the state and federal level. Additionally, it provides the first data describing the population genetics of a Gulf Slope *Elliptio* taxon, and opens the door for more finely resolved comparisons of species and population boundaries within the genus. In addition, my work concentrates the available occurrence data for this species in to a dataset that covers 30 y, and statistically assesses frequency of occurrence using a naïve occupancy approach. Declines in freshwater mussels are commonly discussed in the literature, but are uncommonly tested over long periods of time or by using statistical approaches. My study provides a quantitative, repeatable method that can be employed for *E. arca* in the future, and potentially for other at-risk taxa in the MRB.

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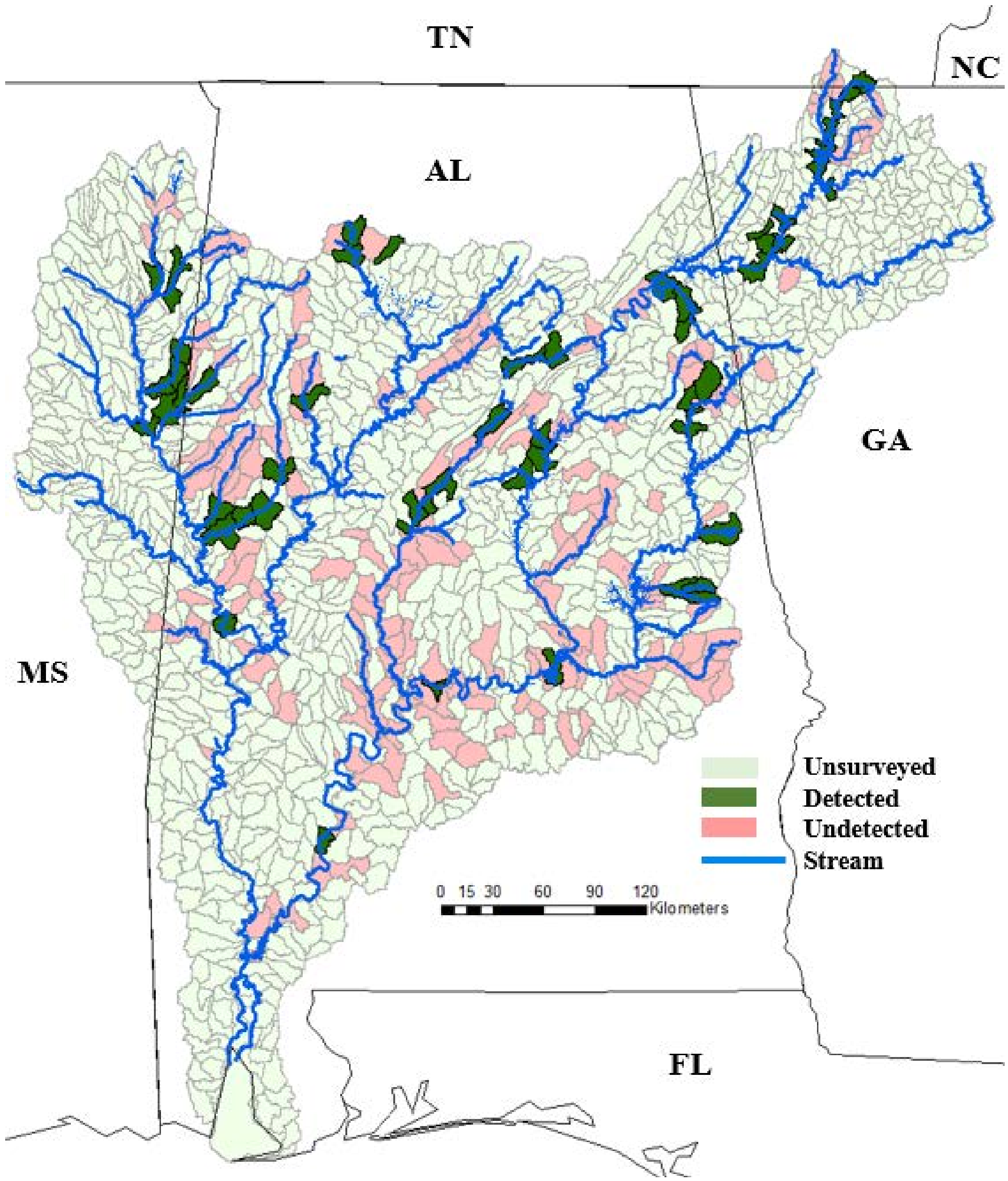

Figure 1. Map of past (1987-2002) detection/non-detection records for *E. arca* in the MRB, represented at the 12 digit HUC scale.

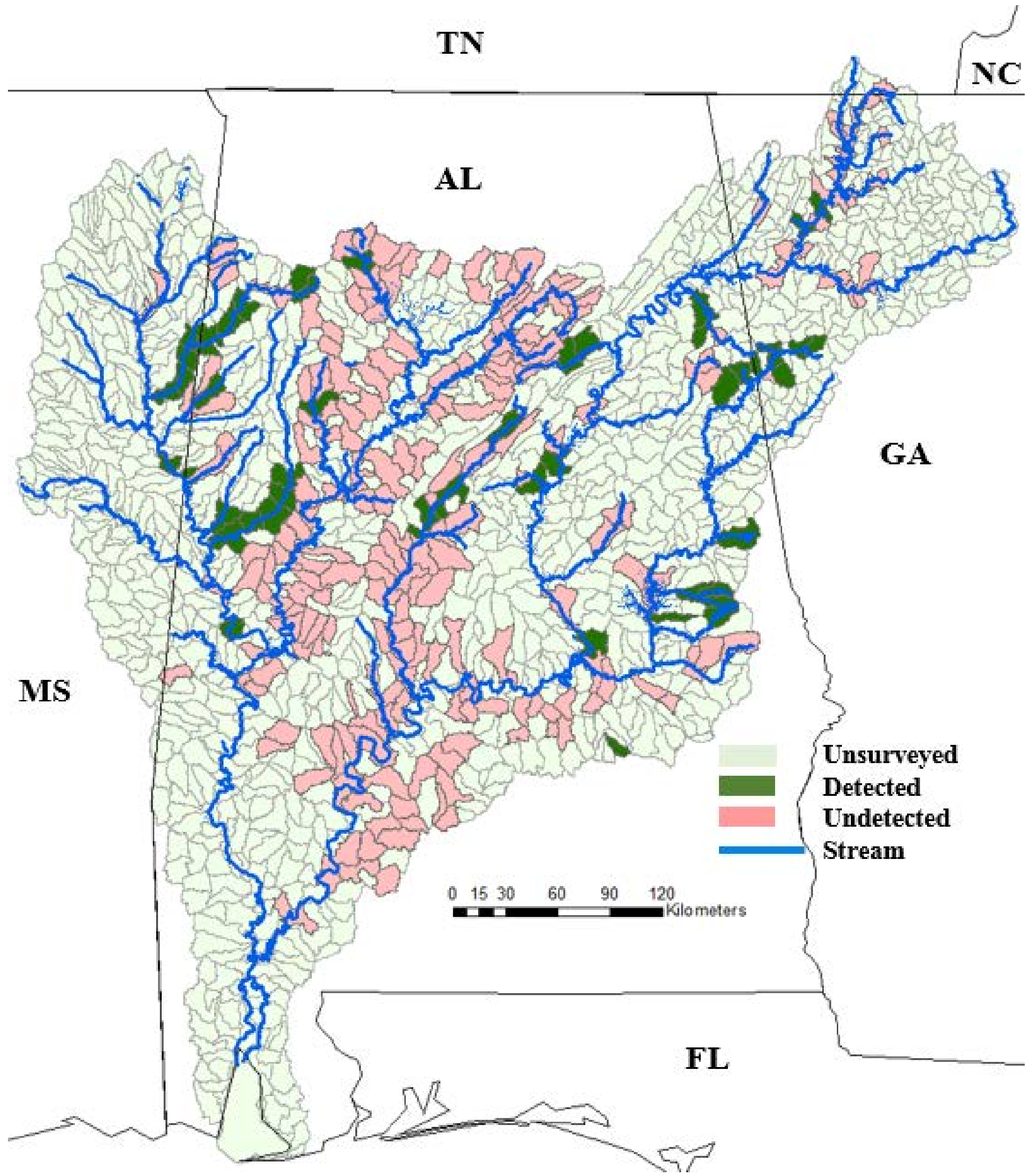

Figure 2. Map of current (2003-2016) detection/non-detection records for *E. arca* in the MRB, represented at the 12 digit HUC scale.

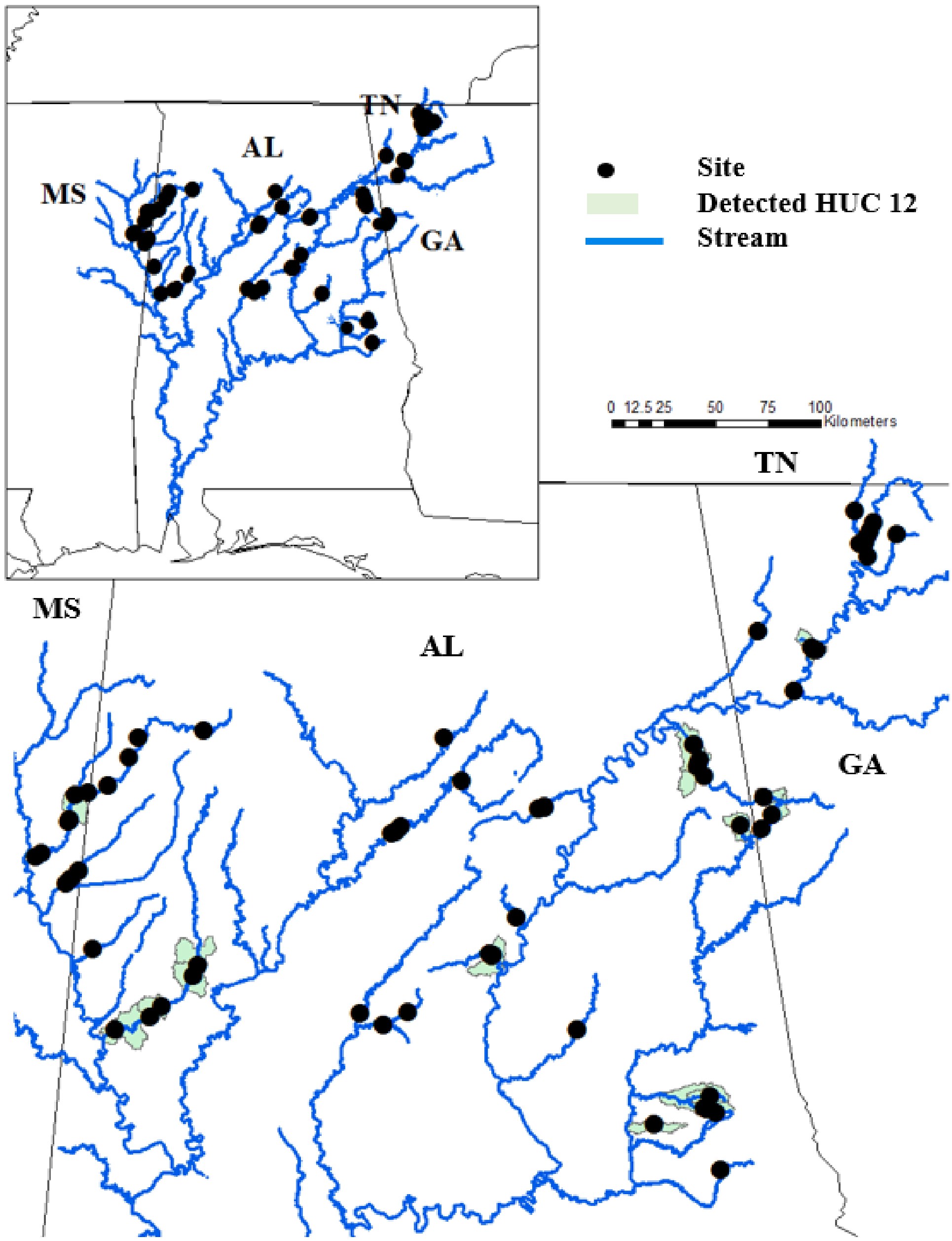

Figure 3. Map of my 2016 surveys and 12 digit HUCs where I detected *E. arca* in the MRB.

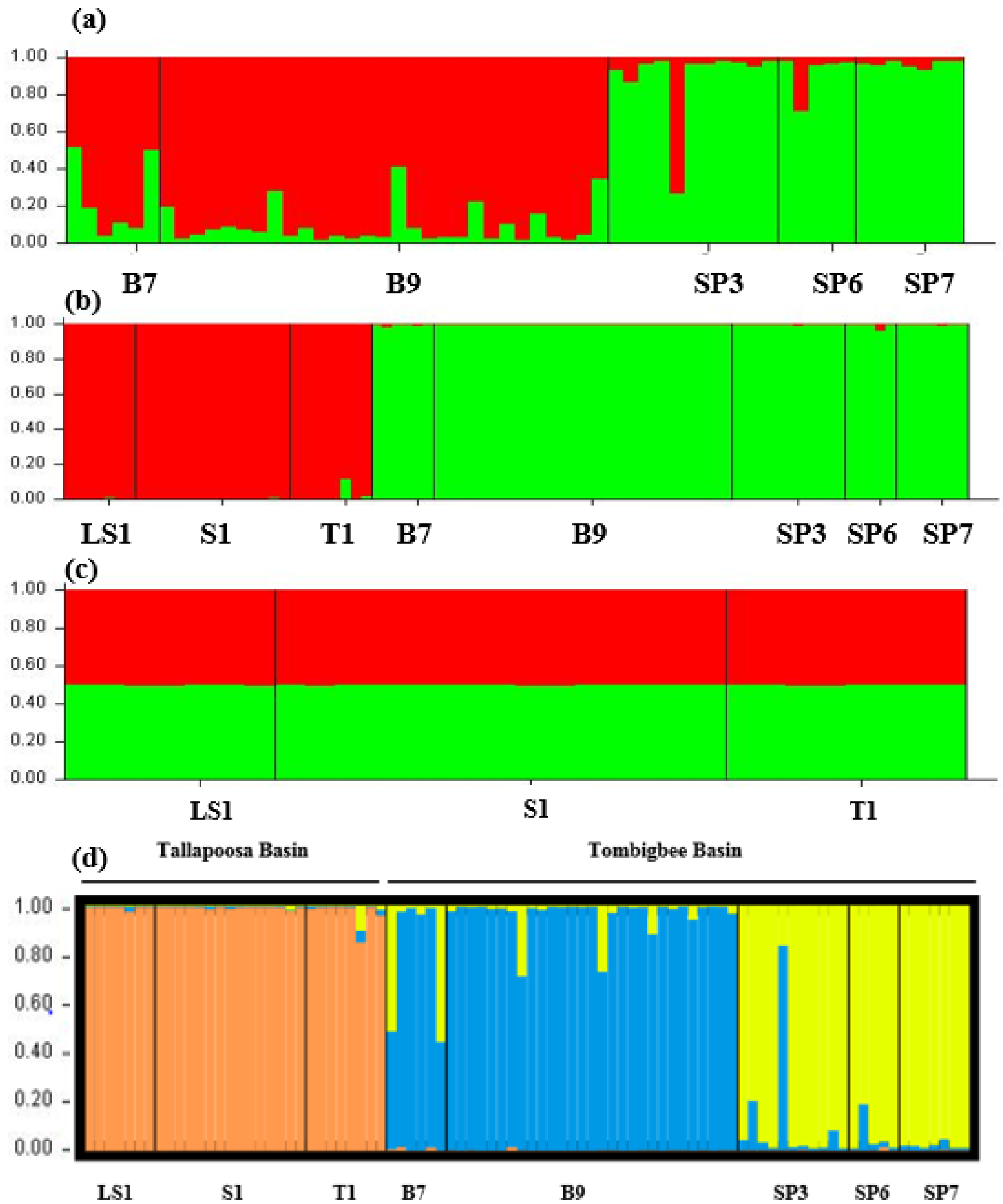

Figure 4. Bar plots depicting results from STRUCTURE analyses for *E. arca*. Bars correspond to multilocus genotypes and colors represent the probability of assignment to each inferred genetic cluster. (a) Most likely clustering scenario (K=2) for individuals from the Tombigbee Drainage. (b) Bar plot of K=2 for all individuals. (c) Bar plot of K=2 for individuals from the Tallapoosa Drainage, showing equal proportions of membership to each inferred cluster. (d) Most likely clustering scenario for all individuals (K=3), with 3 replicate runs processed in DISTRUCT.

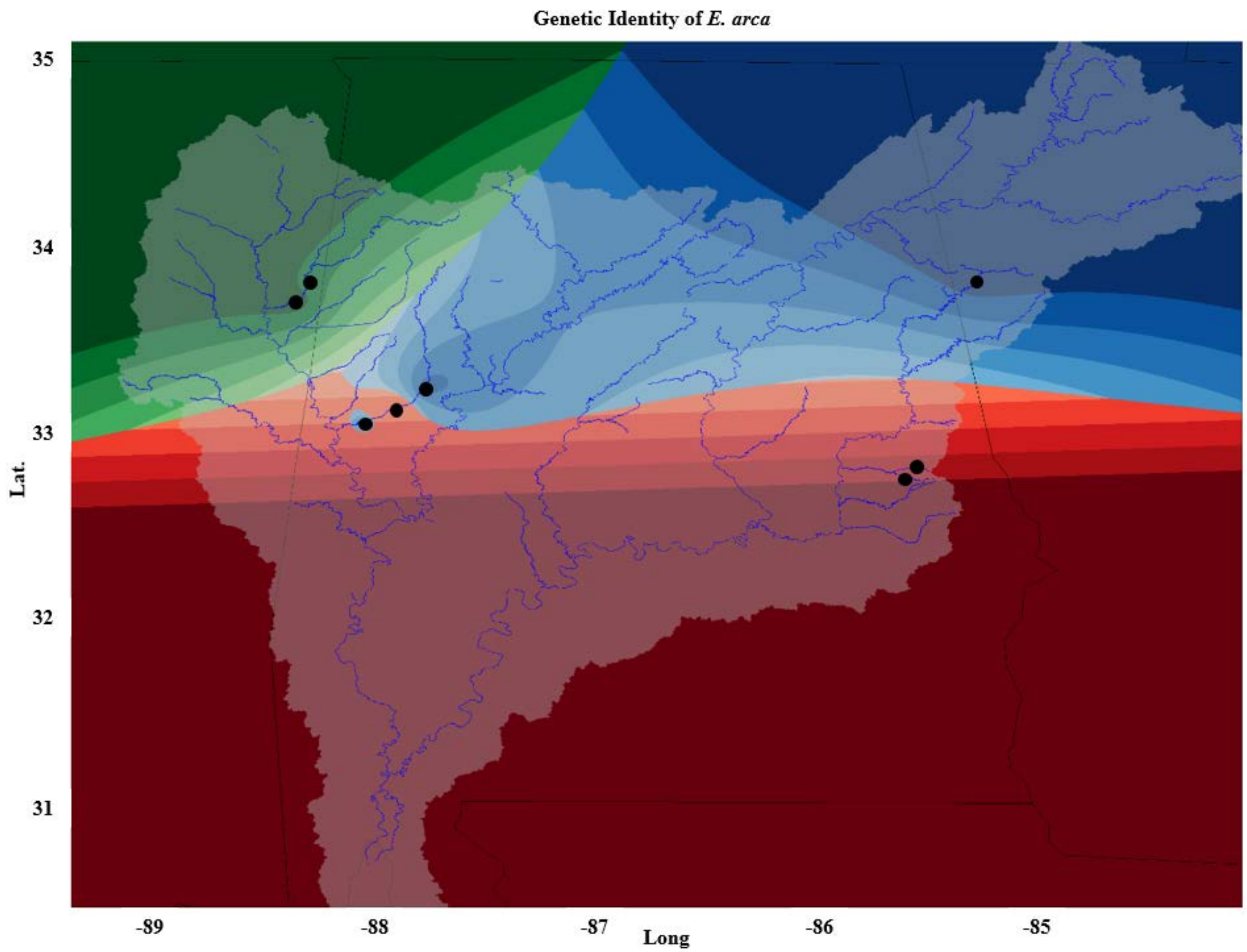

Figure 5. STRUCTURE Q-matrix values mapped to the study area using POPSutilities.r in RStudio, showing three genetic clusters (K=3) within *E. arca*.

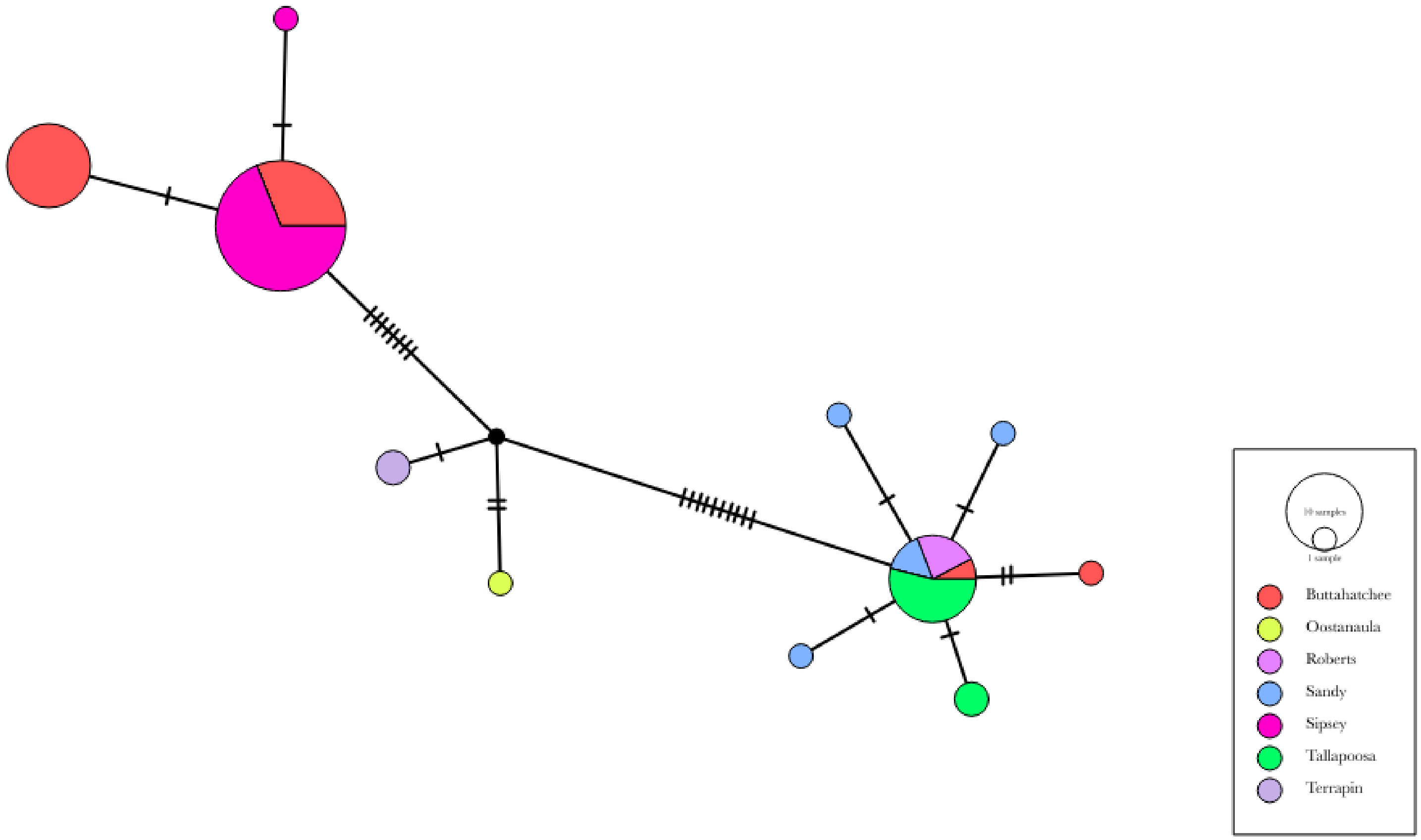

Figure 6. TCS haplotype network of 64 *E. arca*, using *COI* mtDNA data. Streams are color coded, dots represent mtDNA haplotypes, hash marks represent steps between haplotypes in the alignment and black dots represent implied haplotypes.

Table 1. Sample sizes, genetic diversity estimates (averaged over 5 microsatellite loci) and Hardy-Weinberg exact test results for *E. arca* individuals genotyped at loci developed by Ward et al. (2010). A= mean number of alleles, AR= allelic richness, PA= private alleles, H_o= observed heterozygosity, H_e= expected heterozygosity.

Site	**Drainage**	**N**	**A**	**AR**	**PA**	**H_o**	**H_e**
Tallapoosa R. 1	TALL	8	3.6	3.49	7	0.405	0.419
L. Sandy	TALL	7	4	3.59	4	0.476	0.470
Sandy	TALL	15	4.8	3.38	5	0.507	0.469
Buttahatchee 7	TOM	6	3.2	2.9	0	0.400	0.369
Buttahatchee 9	TOM	29	5.4	3.16	3	0.475	0.469
Sipsey 3	TOM	11	5	3.56	2	0.593	0.497
Sipsey 5	TOM	5	3.4	3.4	2	0.440	0.436
Sipsey 6	TOM	7	3.8	3.56	1	0.590	0.525
-	**-**	**Avg.**	**4.15**	**3.38**	**5.25**	**0.486**	**0.457**

Table 2. Summary data from targeted freshwater mussel surveys for *Elliptio arca* in the MRB, including species, number of individuals, sites, streams and 12 digit HUCs at which each species was encountered. CPUE has not been adjusted for effort put forth outside of a species' known area of occurrence.

Species	# of individuals	# of sites	# of streams	# of HUCs	CPUE (individuals/person minute)
Amblema elliotii	54	3	3	4	0.33
Amblema plicata	2	2	2	2	0.012
Ellipsaria lineolata	98	5	2	3	0.6
Elliptio arca	164	21	9	16	1.008
Elliptio crassidens	8	1	1	1	0.048
Epioblasma penita	49	4	1	3	0.3
Fusconaia cerina	71	10	4	8	0.432
Hamiota altilis	30	5	7	6	0.186
Lampsilis ornata	132	19	9	15	0.816
Lampsilis straminea	6	5	2	4	0.036
Lampsilis teres	4	3	3	3	0.024
Lasmigona alabamensis	10	3	1	2	0.06

Table 2 contd.

Species	# of individuals	# of sites	# of streams	# of HUCs	CPUE (individuals/person minute)
Leptodea fragilis	15	8	5	6	0.09
Medionidus acutissimus	71	8	4	7	0.438
Megalonaias nervosa	11	4	4	4	0.066
Obliquaria reflexa	245	12	6	9	1.512
Obovaria unicolor	5	2	2	2	0.03
Plectomerous dombeyanus	1	1	1	1	0.006
Pyganodon grandis	1	1	1	1	0.006
Pleurobema decisum	246	15	5	11	15.162
Pleurobema hanleyianum	1	1	1	1	0.006
Pleurobema perovatum	1	1	1	1	0.006
Potamilus purpuratus	7	4	3	3	0.42
Ptychobranchus greenii	1	1	1	1	0.006
Quadrula asperata	290	24	11	19	1.788
Quadrula rumphiana	20	9	4	7	0.126

Table 2 contd.

Species	**# of individuals**	**# of sites**	**# of streams**	**# of HUCs**	**CPUE (individuals/person minute)**
Quadrula verrucosa	178	25	9	18	1.098
Strophitus connasaugensis	4	3	3	3	0.024
Truncilla donaciformis	5	3	2	2	0.03
Utterbackia imbecillis	20	1	1	1	0.126
Villosa lienosa	9	4	4	4	0.054
Villosa nebulosa	6	4	4	6	0.036
Villosa umbrans	1	1	1	1	0.006
Villosa vibex	12	4	3	12	0.06

Table 3. Sampling site pairwise F_{ST} values averaged across all 5 microsatellite loci. The only comparison that does not represent a statistically significant difference is marked with an asterisk.

	LS1	**S1**	**T1**	**B7**	**B9**	**SP3**	**SP5**	**SP6**
LS1	-							
S1	0.04476	-						
T1	0.11647	0.04598	-					
B7	0.51998	0.53847	0.60748	-				
B9	0.48638	0.49862	0.51982	0.07189	-			
SP3	0.47441	0.50302	0.57214	0.10874	0.16011	-		
SP5	0.45265	0.47710	0.51611	0.16462	0.21609	0.06878	-	
SP6	0.43279	0.46119	0.51956	0.17177	0.20604	0.01683	-0.0008*	-

Appendix A. Sites where I conducted mussel surveys in 2016 and associated metadata. Drainage codes are as follows: TL=Tallapoosa, C=Coosa, CH=Cahaba, BW=Black Warrior, TOM=Tombigbee.

Date	**State**	**Drainage**	**Locality, (site code)**	**HUC 12**	**Latitude**	**Longitude**	**#found**	**Search area (m^2)**	**Effort (person-hours)**	***E. arca* CPUE**
5/16/2016	GA	TL	Tallapoosa River at Poplar Springs. Rd, (T1)	031501080202	33.81422	-85.27589	27	2291.2	6.2	4.32
5/17/2016	AL	C	Yellowleaf Creek 1, (YL1)	031501070205	33.31098	-86.48252	0	1330	8.55	0
5/17/2016	AL	C	Yellowleaf Creek 2, (YL2)	031501070205	33.30735	-86.48527	0	unmeasured	7	0
5/17/2016	AL	C	Yellowleaf Creek 3, (YL3)	031501070205	33.307	-86.48916	0	1104	2.4	0
5/17/2016	AL	C	Yellowleaf Creek 4, (YL4)	031501070205	33.30783	-86.49342	0	unmeasured	7.78	0
5/17/2016	AL	C	Yellowleaf Creek 5, (YL5)	031501070205	33.31222	-86.49652	0	1449	4.43	0
5/18/2016	AL	C	Yellowleaf Creek 6, (YL6)	031501070205			1	unmeasured		
5/18/2016	AL	C	Kelly Creek d/s 231 crossing, (K1)	031501060808	33.44571	-86.38248	0	unmeasured	2.7	0
5/18/2016	AL	C	Big Canoe Creek d/s 231 crossing, (BC1)	031501060305	33.84145	-86.26118	0	1384.6	5.73	0
5/18/2016	AL	C	Big Canoe Creek ~200m u/s 231 crossing, (BC2)	031501060305	33.837849	-86.261068	0	unmeasured	1	0

Appendix A contd.

Date	State	Drainage	Locality, (site code)	HUC 12	Latitude	Longitude	#found	Search area (m^2)	Effort (person-hours)	*E. arca* CPUE
5/19/2016	AL	C	Terrapin Creek at No Worries Outfitters, (TR1)	031501050909	34.06376	-85.61324	0	3423.3	5.5	0
5/19/2016	AL	C	Terrapin Creek ~400m d/s from No Worries Outfitters, (TR2)	031501050909			6	unmeasured	2.8	2.1
5/19/2016	AL	C	Terrapin Creek ~200m u/s from 278 crossing, (TR3)	031501050906	33.95194	-85.56971	0	875	4.7	0
5/31/2016	GA	C	Conasauga River ~500m u/s of Norton Bridge Rd.	031501010204	34.85341	-84.84055	0	1674	unmeasured	0
5/31/2016	GA	C	Conasauga River ~300 m d/s Hwy 286 bridge	031501010211	34.82542	-84.85133	0	2070	2.65	0
6/1/2016	GA	C	Conasauaga River ~200 m d/s Mitchell Bridge Rd.	031501010211	34.80952	-84.86095	0	1400	5.8	0
6/1/2016	GA	C	Conasauga River d/s Hwy 76	031501010211	34.78216	-84.87355	0	680	4.26	0
6/1/2016	GA	C	Conasauga River ~500m d/s of Tibbs Bridge Rd.	031501010211	34.73505	-84.86108	0	unmeasured	4.15	0

Appendix A contd.

Date	State	Drainage	Locality, (site code)	HUC 12	Latitude	Longitude	#found	Search area (m^2)	Effort (person-hours)	*E. arca* CPUE
6/2/2016	GA	C	Coahulla Creek at Praters Mill	031501010304	34.8956	-84.92088	0	333.3	1.5	0
6/2/2016	GA	C	Coahulla Creek d/s Hwy 76	031501010307	34.77757	-84.89632	0	806.3	2.6	0
6/17/2016	AL	TL	Little Loblockee Creek 50m d/s from CR 86 (Gold Hill Rd.), (LB1)	031501100401	32.684975	-85.560374	1	174	2.2	0.42
6/17/2016	AL	TL	Little Sandy Creek~20m u/s CR 11 bridge, (LS1)	031501090501	32.79929	-85.54351	24	247	1.9	12.6
6/17/2016	AL	TL	Sandy Creek ~50m u/s from CR 11, (S1)	031501090503	32.75461	-85.57146	7	853.3	1.16	6
6/18/2016	AL	TL	Sandy Creek ~500m d/s of CR 20 crossing, (S2)	031501090503	32.73768	-85.52065	1	210	1.03	0.96
6/18/2016	AL	C	Hatchet Creek ~1 km u/s from Hwy 280 crossing, (H1)	031501070706	33.0405	-86.1174	0	459.3	3.36	0
6/19/2016	AL	C	Hatchet Creek at CR 511 bridge, (H2)	031502020403	33.08131	-86.8353	0	238	1.43	0

Appendix A contd.

Date	**State**	**Drainage**	**Locality, (site code)**	**HUC 12**	**Latitude**	**Longitude**	**#found**	**Search area (m^2)**	**Effort (person-hours)**	***E. arca* CPUE**
6/19/2016	AL	TL	Sandy Creek ~150m d/s Jones Mill dam, (S3)	031501090503	32.75283	-85.561071	3	177.3	1.26	2.34
6/20/2016	AL	TL	Sandy Creek at Jones Mill dam, (S4)	031501090503	32.75056	-85.55898	9	187	3.66	2.4
6/25/2016	AL	TL	Chewacla u/s of Parkerson Mill confluence	031501100202	32.53233	-85.49834	0	2286	3.7	0
6/26/2016	AL	TL	Robert's Creek ~30m u/s from CR 49 bridge, (R1)	031501080303	33.77422	-85.41458	9	275	0.86	10.38
6/26/2016	AL	C	Terrapin Creek 4, (TR4)	031501050908	33.98359	-85.60189	0	703	1.9	0
6/26/2016	AL	C	Terrapin Creek 5, (TR5)	031501050908	33.99579	-85.5965	1	unmeasured	unmeasured	unmeasured
6/26/2016	AL	C	Terrapin Creek 6, (TR6)	031501050908	33.9974	-85.59532	1	1440	0.86	1.14
6/27/2016	AL	C	Terrapin Creek 7, (TR7)	031501050908	34.00892	-85.58743	0	357	0.96	0
7/4/2016	AL	C	Big Canoe Creek ~40m d/s Hwy 36 bridge	031501060303	33.83309	-86.28382	0	303.3	1.56	0
7/5/2016	AL	BW	Locust Fork 50m u/s Olive Church Rd. Bridge	031601110404	33.74523	-86.91887	0	7920	1.33	0

Appendix A contd.

Date	**State**	**Drainage**	**Locality, (site code)**	**HUC 12**	**Latitude**	**Longitude**	**#found**	**Search area (m^2)**	**Effort (person-hours)**	***E. arca* CPUE**
7/5/2016	AL	BW	Duck River 530m u/s CR 747, (D1)	031601090109	34.09138	-86.69653	0	464.6	2.03	0
7/6/2016	AL	BW	Little Warrior River ~200m d/s from Low Water Bridge Rd. crossing	031601110207	33.93386	-86.61629	0	225.3	0.5	0
7/7/2016	AL	TOM	Sipsey River just d/s of Hwy 82 bridge	031601070301	33.27251	-87.75473	4	863.3	4.43	0.9
7/7/2016	AL	TOM	Sipsey River ~200 d/s from Hwy 14 bridge	031601070306	33.04031	-88.1139	0	200	1.96	0
7/9/2016	AL	TOM	Coal Fire Creek ~50m u/s CR 26, (CF1)	031601060203	33.3283	-88.20967	0	505.6	1.13	0
7/9/2016	AL	CH	Little Cahaba River ~150m d/s from CR 10 crossing	031502020405	33.05652	-86.95451	0	910	1.46	0
7/10/2016	AL	CH	Cahaba River at CR 24 bridge	031502020407	33.09668	-87.0545	0	2867	1.4	0
7/10/2016	AL	TOM	Sipsey River on Weyerheuser property/hunting club	031601070305	33.12156	-87.91098	15	95	3.1	4.8

Appendix A contd.

Date	State	Drainage	Locality, (site code)	HUC 12	Latitude	Longitude	#found	Search area (m^2)	Effort (person-hours)	*E. arca* CPUE
7/10/2016	AL	TOM	Sipsey River on Weyerheuser property	031601070305	33.08717	-87.96176	0	979	2.65	0
7/28/2016	MS	TOM	Sipsey River	031601070306	33.041	-88.035	5	unmeasured	1.25	3.6
7/28/2016	MS	TOM	Yellow Creek ~570m d/s from Steens Rd., (Y1)	031601050405	33.56591	-88.32423	0	319	1.6	0
7/30/2016	AL	TOM	Yellow Creek 1.86 km u/s from Steens Rd., (Y2)	031601050405	33.58245	-88.30698	0	unmeasured	2.05	0
7/30/2016	AL	TOM	Buttahatchee River 110 m d/s from Hwy 17 bridge	031601030306	33.91848	-88.14751	0	1333	1.3	0
7/30/2016	AL	TOM	Buttahatchee River 396m d/s from Henson Springs Rd	031601030304	34.01659	-88.05618	0	490.6	2	0
7/30/2016	AL	TOM	Buttahatchee River 50m u/s CR 35	031601030303	34.09098	-88.01294	0	343	1.8	0
7/31/2016	MS	TOM	Buttahatchee River ~20m u/s from Hwy 129 bridge	031601030102	34.11283	-87.73106	0	1152	1.85	0
9/7/2016	MS	TOM	Buttahatchee River 259m d/s of SR 373	031601030604	33.66286	-88.45955	0	1258	1.5	0

Appendix A contd.

Date	**State**	**Drainage**	**Locality, (site code)**	**HUC 12**	**Latitude**	**Longitude**	**#found**	**Search area (m^2)**	**Effort (person-hours)**	***E. arca* CPUE**
9/7/2016	MS	TOM	Buttahatchee River 134 d/s Hwy 45 xing	031601030604	33.6735	-88.43081	0	1196	1.3	0
9/7/2016	MS	TOM	Buttahatchee River 140m u/s Lawrence bridge Rd.	031601060308	33.703903	-88.34601	5	256	3.05	1.62
9/8/2016	MS	TOM	Buttahatchee River 212m d/s from Bartahatchie Rd. crossing	031601030603	33.78842	-88.31584	0	273	0.95	0
9/8/2016	MS	TOM	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	031601030602	33.7933	-88.31092	13	176	0.45	2.76
9/9/2016	MS	TOM	Buttahatchee River 792 m u/s Bartahatchie Rd. crossing	031601030602	33.79646	-88.31074	22	886.6	4.4	4.98
9/9/2016	AL	TOM	Buttahatchee River 261m u/s Hwy 278	031601030601	33.88536	-88.28867	0	90.6	3.25	0
10/11/2016	GA	TOM	Buttahatchee River ~600m u/s Gattman Bottom Rd. boat launch	031601030306	33.89283	-88.22847	0	58.6	0.85	0
10/11/2016	GA	C	Chattooga River d/s Hwy 27 near Summerville	031501050602	34.46662	-85.333691	0	450	1.2	0

Appendix A contd.

Date	State	Drainage	Locality, (site code)	HUC 12	Latitude	Longitude	#found	Search area (m^2)	Effort (person-hours)	*E. arca* CPUE
10/12/2016	GA	C	Coosa River d/s of Oostanaula River confluence near Rome	031501050201	34.25534	-85.17862	0	unmeasured	0.86	0
10/12/2016	GA	TL	Little Creek from Hwy 100 u/s towards Steadman Rd. bridge, (L1)	031501080201	33.87812	-85.31087	1	unmeasured	unmeasured	unmeasured
10/13/2016	GA	TL	Tallapoosa River d/s of Broad St. bridge crossing, (T2)	031501080206	33.76395	-85.32265	0	unmeasured	1.3	0
10/13/2016	GA	C	Oostanaula River above Hwy 140 bridge, ~50 u/s of historical point, (O1)	031501030601	34.41082	-85.10777	0	800	1.2	0
10/13/2016	GA	C	Oostanaula River, (O2)	031501030601	34.40335	-85.09686	1	1000	1.53	0.6
10/14/2016	GA	C	Oostanaula River, (O3)	031501030601	34.40113	-85.08672	0	375	1.06	0
10/28/2016	GA	C	Holly Creek ~40m d/s Tom Terry Rd., (H1)	031501010402	34.811438	-84.735553	0	150	1.06	0

Appendix A contd.

Date	State	Drainage	Locality, (site code)	HUC 12	Latitude	Longitude	#found	Search area (m^2)	Effort (person-hours)	*E. arca* CPUE
10/28/2016	AL	BW	Locust Fork at Black Creek mine re-survey reach 1	031601110404	33.7575	-86.89674	0	756	2.8	0
10/28/2016	AL	BW	Locust Fork at Black Creek mine re-survey reach 2	031601110404	33.7575	-86.89674	0	816.6	2.8	0
10/29/2016	AL	BW	Locust Fork upstream of Crooked Creek confluence	031601110402	33.77272	-86.88201	0	unmeasured	2.3	0
10/29/2016	AL	BW	Locust Fork at Dale Pardue put-in off Mt. Olive Rd.	031601110404	33.74988	-86.90447	0	2836.3	4	0
10/29/2016	AL	TOM	Sipsey River lower Forever Wild Tract, (SP6)	031601070302	33.23177	-87.77766	8	unmeasured	1.8	3.84

Appendix B. Table of *E. arca* detection records, using data from collaborators' collections, museum specimens, the AL Natural Heritage Database, unpublished reports, theses and dissertations and M. Gangloff collections. Drainage codes are as follows: TL=Tallapoosa, C=Coosa, CH=Cahaba, BW=Black Warrior, TOM=Tombigbee.

Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
8/27/1987	MS	Lowndes	031601030604	TOM	Buttahatchie River from Hwy 45 bridge upstream around 4 miles	33.6717707	-88.4117556	P.Hartfield, R. Jones
9/2/1987	MS	Itawamba	031601011003	TOM	East Fork Tombigbee River bars between Mill Creek and Barrs Ferry	34.1020373	-88.4135073	P.Hartfield, D.Miller
1/26/1988	GA	Bradley	031501010103	C	Conasauga River at Rt. 74	34.990496	-84.77498	Unknown
5/6/1988	GA	Gordon	031501010504	C	Coosawattee River at confluence w/ Conasauga River	34.54333115	-84.90277863	Biggins, D.
8/5/1988	MS	Itawamba	031601011003	TOM	East Fork Tombigbee River between Mill Creek and Bull Mountain Creek	34.102106	-88.416934	P.Hartfield, R.Jones, T.Majure
8/19/1988	AL	Greene	031601070305	TOM	Sipsey River at St. Hwy 23	33.1016621	-87.9502917	P.Hartfield, R.Jones, T.Majure
8/1/1989	MS	Monroe	031601030604	TOM	Buttahatchee River just above MS 373 bridge at Columbus Air Force Base. T16S, R18W, Section 19.	33.6634232	-88.4557189	P.Hartfield, R.Jones, T.Majure
8/2/1989	MS	Monroe	031601030604	TOM	Buttahatchee River above U.S. 45 Bridge. T16S R18W Section 15.	33.6731018	-88.4112811	R.Jones,P.Hartfield,T.Majure,K.Macaro

Appendix B contd.

Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
8/3/1989	MS	Monroe	031601011004	TOM	East Fork Tombigbee River from Old Smithville Bridge downstream to Tenn-Tom Lock B spillway	34.0790115	-88.4293808	R.Jones, P.Hartfield, K. Macaro
8/3/1989	MS	Itawamba	031601011003	TOM	East Fork Tombigbee River from old Smithville Bridge upstream to Mill Creek. T11S,R8E,S23,24,26.	34.1020373	-88.4135073	R.Jones, P.Hartfield, K. Macaro
8/15/1989	MS	Monroe	031601030604	TOM	Buttahatchee River above U.S. 45 bridge. T16S R18W section 15.	33.6731018	-88.4112811	R.Jones,P.Harrtfield,T. Majure,K.Macaro
8/16/1989	MS	Monroe	031601030604	TOM	Buttahatchee River CA. 2.75 air miles above U.S. 45. T16S R18W NE/4 section 11.	33.692116	-88.3950962	R.Jones,T.Majure,P.Hartfield,K.Macaro
8/24/1989	MS	Monroe	031601030603	TOM	Buttahatchee River above Lawrence Bridge NW of Caledonia. T15S R17W section 32.	33.715241	-88.3379079	R.Jones, T.Majure, P.Hartfield
9/10/1989	GA	Gordon	031501010504	C	Coosawattee River at confluence w/ Conasauga River	34.54360962	-84.90277863	Freeman, B.
7/3/1990	MS	Monroe	031601011004	TOM	East Fork Tombigbee R. from Itawamba Co. line downstream to channel split. T11S,R8E,NW/4 Sec. 35.	34.0810309	-88.4240067	R.Jones, R.Noland
7/3/1990	MS	Itawamba	031601011003	TOM	East Fork Tombigbee River from Old Smithville bridge upstream to Mill Creek. T11S,R8E,S.23,24,26.	34.1020373	-88.4135073	R.L.Jones, R.Noland

Appendix B contd.

Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
7/18/1990	MS	Monroe	031601030604	TOM	Buttahatchee River from Caledonia Bridge upstream CA. 1.5 MILES. T15S,R17W, Sec 32.	33.6731018	-88.4112811	R.Jones,K. Macaro,R.Noland
7/18/1990	MS	Monroe	031601030603	TOM	Buttahatchee River 1.25-2.0 air miles above Lawrence Bridge NW of Caledonia. T15S,R17W,S.32and33.	33.7165345	-88.3325537	R.Jones,R.Noland,K.Macaro
7/19/1990	MS	Monroe	031601030603	TOM	Buttahatchee River 2.1-2.8 air miles above Lawrence Bridge NW of Caledonia. T15S,R17W,S.28.	33.7308912	-88.3267528	R.Jones,R.Noland,K.Macaro
7/20/1990	MS	Lowndes	031601030604	TOM	Buttahatchee River at gravel bar CA. 0.1 mile above MS 373 bridge. T16S R18W Section 19.	33.6620984	-88.4556426	R.Jones, R.Noland, K.Macaro
7/20/1990	MS	Monroe	031601030604	TOM	Buttahatchee River from US 45 bridge upstream CA. 2 river miles. T16S R18W Sections 15 and 16.	33.6676546	-88.4183753	R.Jones, R.Noland, K.Macaro
7/25/1990	MS	Monroe	031601030603	TOM	Buttahatchee River 0.5 air miles above and below Old Rye bridge T15S,R17W,Sec 21	33.7308912	-88.3267528	R.L. Jones, K. Macaro, R. Noland
7/27/1990	MS	Monroe	031601030603	TOM	Buttahatchee River 0.6-1.6 air miles below Cockerham Bridge. T15S,R17W, Section 10.	33.7740128	-88.312817	R.Jones,R.Noland,K.Macaro
8/1/1990	MS	Monroe	031601030603	TOM	Buttahatchee River 0.15-0.4 air miles below Cockerhan Bridge. T15S,R17W, Section 4.	33.7858233	-88.3182139	R.Jones,R.Noland,K.Macaro,D.Byrd

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Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
8/2/1990	MS	Monroe	031601030602	TOM	Buttahatchee River 0.1-0.5 air miles above Cockerham Bridge. T15S,R17W, Section 3.	33.7904525	-88.3137268	R.Jones,R.Noland,K.Macaro,D.Byrd
8/2/1990	MS	Monroe	031601030602	TOM	Buttahatchee River 0.65-1.6 air miles above Cockerham Bridge. T14S,R17W, Section 34.	33.8030002	-88.3100295	R.Jones,R.Noland,K.Macaro,D.Byrd
8/7/1990	MS	Monroe	031601030602	TOM	Buttahatchee River 1.8-2.5 air miles above Cockerham Bridge. T14S,R17W, Section 27.	33.8179491	-88.3086584	R.Jones,R.Noland,K.Macaro,D.Byrd
9/29/1990	AL		031601070305	TOM	Sipsey River	33.11135	-87.9385	Pierson, Malcolm J.
9/29/1990	AL	Tuscaloosa		TOM	Sipsey River from State Highway 14 u/s to Hwy 82			Pierson, M.
10/4/1990	AL	Pickens		TOM	Lubbub Creek from Hwy 14 u/s to CR 22			Pierson, M.
1990	MS	Monroe	031601030604	TOM	Downstream of MS 373	33.66551	-88.46282	P.Hartfield, R.Jones
1990	MS	Monroe	031601030604	TOM	Shoal complex upstream of TTW confluence	33.66642219	-88.47455977	P.Hartfield, R.Jones
1990	MS	Monroe	031601030604	TOM	Shoal complex upstream of TTW confluence	33.6676775	-88.47395938	P.Hartfield, R.Jones
1990	MS	Monroe	031601030604	TOM	B015	33.669412	-88.440929	P.Hartfield, R.Jones

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Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
1990	MS	Monroe	031601030604	TOM	Just upstream from MS 373 crossing	33.67002	-88.4508	P.Hartfield, R.Jones
1990	MS	Monroe	031601030604	TOM	Shoal upstream of RR Bridge, downstream of power line break	33.67131	-88.41548	P.Hartfield, R.Jones
1990	MS	Monroe	031601030604	TOM	First shoal upstream from US 45	33.67484	-88.42722	P.Hartfield, R.Jones
1990	MS	Monroe	031601030604	TOM	Buttahatchee River B46/47	33.688556	-88.366178	P.Hartfield, R.Jones
1990	MS	Monroe	031601030603	TOM	Buttahatchee River First shoal upstream of Caledonia Road	33.70746	-88.34407	P.Hartfield, R.Jones
1990	MS	Monroe	031601030603	TOM	Buttahatchee River First shoal upstream old Rye Bottom Road bridge	33.74554	-88.31902	P.Hartfield, R.Jones
1990	MS	Monroe	031601030603	TOM	Buttahatchee River Third shoal upstream old Rye Bottom Road crossing	33.74958	-88.32146	P.Hartfield, R.Jones
1990	MS	Monroe	031601030603	TOM	Buttahatchee River Shoal upstream from Rye Bottom Road crossing	33.75695	-88.32107	P.Hartfield, R.Jones
1990	MS	Monroe	031601030603	TOM	Buttahatchee River Shoal just downstream from Bartahatchee Bridge	33.78864	-88.3157	P.Hartfield, R.Jones
1990	MS	Monroe	031601030602	TOM	Buttahatchee River 0.5 km upstream from Bartahatchie Road	33.79352	-88.31192	P.Hartfield, R.Jones

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Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
1990	MS	Monroe	031601030602	TOM	2 km upstream from Bartahatchie Road	33.79924	-88.30944	P.Hartfield, R.Jones
1990	MS	Monroe	031601030602	TOM	Upstream from Bartahatchee just above power/gas line crossing	33.80827	-88.31005	P.Hartfield, R.Jones
1990	MS	Monroe	031601030602	TOM	Shoal at upper Wildlife Mississippi property access	33.8437	-88.31088	P.Hartfield, R.Jones
1990	MS	Monroe	031601030602	TOM	Buttahatchee River B120	33.88231	-88.28917	P.Hartfield, R.Jones
1990	MS	Monroe	031601030601	TOM	Between RR Bridge and 278 near Bend.	33.885702	-88.288322	P.Hartfield, R.Jones
1990	MS	Monroe	031601030601	TOM	Shoal complex 200 m downstream of RR Bridge crossing	33.88617486	-88.28417292	P.Hartfield, R.Jones
1990	MS	Monroe	031601030306	TOM	Upstream from Gattman, MS launch	33.89283	-88.22847	P.Hartfield, R.Jones
7/19/1991	AL	Greene	031601070305	TOM	Sipsey River nr. Greene County Road 156 crossing	33.1031	-87.9504	M. Pierson.
8/20/1991	MS	Itawamba	031601011003	TOM	East Fork Tombigbee River from Mill Creek downstream to Old Smithville Bridge site.	34.1020373	-88.4135073	R.Jones,T.Majure

Appendix B contd.

Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
8/21/1991	MS	Monroe	031601030603	TOM	Buttahatchee River, Lawrence Bridge upstream CA. 1.5 air mi. T16S,R17W,Sec. 5 TO T15S,R17W Sec. 32	33.7060595	-88.3437974	R.Jones,T.Majure
8/21/1991	MS	Monroe	031601030603	TOM	Buttahatchee River between Caledonia Bridge and T15S R17W Section 33.	33.7205607	-88.3288386	R.Jones, T.Majure
8/22/1991	MS	Monroe	031601030604	TOM	Buttahatchee River from US 45 bridge upstream to railroad bridge. T16S,R18W, Section 16.	33.6699108	-88.4213677	R.Jones,T.Majure
8/24/1991	AL	Pickens	031601070305	TOM	Sipsey River	33.12167	-87.90583	Pierson, J. M.
9/26/1991	AL	Greene	031601070306	TOM	Sipsey River	33.05417	-88.03917	Pierson, J. M.
9/27/1991	AL	Pickens	031601070305	TOM	Sipsey River	33.08722	-87.95833	Pierson, J. M.
10/20/1991	AL	Greene	031601070303	TOM	Sipsey River	33.13028	-87.895	Pierson, J. M.
11/14/1991	AL	Greene	031601070306	TOM	Sipsey River	33.03333	-88.10722	Pierson, J. M.
6/4/1992	AL	Bibb		CH	Cahaba River AL 5 crossing 6.5 km N of Centreville			Unknown
6/19/1992	AL	Winston	031601100202	BW	Mouth of Capsey Creek in the Black Warrior Drainage system	34.2513	-87.24525	McGregor, Stuart W.

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Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
6/19/1992	AL	Winston	031601100202	BW	Capsey Creek at its confluence with Brushy Creek	34.25150	-87.2451	SWM, Leigh Ann McDougal, Jennifer Fisher
6/26/1992	AL	Winston	031601100103	BW	Sipsey Fork at low water bridge	34.2253	-87.37675	McGregor, Stuart W.
6/26/1992	AL	Winston	031601100103	BW	Sipsey Fork at low water bridge just upstream of Alabama Highway 33 bridge	34.22550	-87.3768	SWM, Leigh Ann McDougal, Bob Butler, Paul Hartfield, Jennifer Fisher
8/17/1992	MS	Itawamba	031601011003	TOM	East Fork Tombigbee from Mill Creek to Old Smithville Bridge site downstream.	34.1020373	-88.4135073	R.Jones,T.Majure
8/18/1992	MS	Monroe	031601030603	TOM	Buttahatchee River from Cockerham Bridge to 0.55 air mi. downstream. T15S,R17W, Sections 3 and 4.	33.7843161	-88.3174779	R.Jones,T.Majure
8/19/1992	MS	Monroe	031601030603	TOM	Buttahatchee River 0.55-2 air mi. upstream of Lawrence Bridge.T16S,R17W,Sec. 5 to T15S,R17W Sec. 33	33.711119	-88.3421173	R.Jones,T.Majure
8/26/1992	AL	Winston	031601100103	TOM	Sipsey Fork at Forest Service Road 228-B	34.25990	-87.3747	SWM, TES
8/26/1992	AL	Winston	031601100103	TOM	Sipsey Fork at Forest Service Road 228-B	34.27145	-87.363	McGregor, Stuart W.

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Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
9/10/1992	AL	Winston	031601100103	TOM	Sipsey Fork between Caney Cr. and river crossing Bankhead NF T9S R8W Sec. 33 NE1/4	34.225384	-87.376775	J.C. Godwin, M.A. Bailey
8/5/1993	MS	Monroe	031601030604	TOM	Buttahatchee River, T16S R18W Sec. 15.	33.6741267	-88.409982	P.Hartfield, D.Patrick
8/16/1993	MS	Monroe	031601030603	TOM	Buttahatchee River from Caledonia Bridge upstream CA. 2.0 miles.	33.7205607	-88.3288386	R.Jones, T.Majure, C.Knight
8/17/1993	MS	Itawamba	031601011003	TOM	East Fork Tombigbee River from Mill Creek downstream to Old Smithville Bridge site.	34.1020373	-88.4135073	R.Jones, C.Knight, T.Majure
8/19/1993	MS	Monroe	031601030603	TOM	Buttahatchee River from Cockerham Bridge downstream CA 1.5 miles.	33.7808936	-88.3162159	R.Jones, C.Knight, T.Majure
8/27/1993	MS	Lowndes	031601050501	TOM	Luxapallila Creek from Steens to Columbus.	33.547357	-88.3647506	P.Hartfield
9/15/1993	GA	Murray	031501010105	C	Conasauga River 0.75 mi below Perry Creek	34.970201	-84.781831	P.D. Hartfield
10/3/1993	AL	Tuscaloosa		BW	North River at CR 63 1.5 mi E of New Lexington			SWM
1993	AL	Winston	031601100103	BW	Sipsey Fork near confluence with Hurricane Creek	34.25306	-87.36722	Haag and Warren
3/30/1994	AL	Cleburne	031501080403	TAL	Cane Creek, gravel road 402 West off of Road 65.	33.751597	-85.480273	Hartfield, McDougal, Thurwood

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Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
4/20/1994	AL	Lawrence	031601100101	BW	Flannagan Creek FSR 208 Bankhead NF	34.340826	-87.471228	P. Hartfield
8/19/1994	MS	Lowndes	031601030603	TOM	Buttahatchee River CA 2 air mi. upstream from Lawrence Bridge. T15S R17W NW4 Sec. 33.	33.7205607	-88.3288386	R.Jones, C.Knight, T.Majure
1995	AL	Cleburne	031501081004	TAL	Carr Creek	33.50997	-85.62825	DeVries, Dennis R.
1995	AL	Cleburne	031501080404	TAL	Snake Creek	33.5925	-85.6095	DeVries, Dennis R.
4/25/1996	AL	Monroe	031502040105	AL	Alabama River ~ 7 mi. upstream of Claiborne Dam	31.70361	-87.5161111	PEO, TES
6/20/1996	AL	Greene	031601070306	TOM	Sipsey River between Hwy. 14 and RR bridge	33.03722	-88.1186111	SWM,TES
6/20/1996	AL	Pickens	031601070306	TOM	Sipsey River 0.25 mi. downstream of AL Hwy. 14	33.041344	-88.114502	McGregor, Stuart W.
7/31/1996	MS	Lowndes	031601050501	TOM	Luxapallila Creek above Waterworks approximately five miles.	33.5278327	-88.3865616	B.Hubbard, C. Watts, C. Couret
9/14/1996	AL	Pickens	031601060408	TOM	Lubbub Ck., CR 24, 3.25 mi. NE Aliceville	33.15	-88.11	Dr. David Campbell.
4/1/1997	AL	Winston	031601100202	BW	Mouth of Hurricane Ck. near FS Rd. 242, Bankhead NF	34.2529	-87.3672	Dr. David

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Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
4/15/1997	AL	Cherokee		C	Terrapin Creek At CR8			Unknown
8/21/1997	GA	Floyd	031501030603	C	Oostanaula River Jones Bend, ~2.4 km SW of the mouth of Armuchee Creek.	34.32638686	-85.14194253	J. Williams and M. Hughes
8/21/1997	GA	Floyd	031501030603	C	Oostanaula River Jones Bend, ~2.4 km SW of the mouth of Armuchee Creek.	34.32693758	-85.14111169	J. Williams and M. Hughes
8/21/1997	GA	Floyd	031501030506	C	Lavender Creek near Little Texas Valley Rd. NW	34.37350082	-85.20059204	Hughes, M.
8/22/1997	GA	Floyd	031501030601	C	Oostanaula River ~0.8 to 1.6 km UPS from the mouth of Armuchee Creek, ~4 km WNW of Shannon, GA.	34.35388581	-85.11417168	J. Williams and M. Hughes
8/22/1997	GA	Floyd	031501030601	C	Oostanaula River ~0.8 to 1.6 km UPS from the mouth of Armuchee Creek, ~4 km WNW of Shannon, GA.	34.35472368	-85.11444083	J. Williams and M. Hughes
8/22/1997	GA	Floyd	031501030601	C	Oostanaula River ~0.8 to 1.6 km UPS from the mouth of Armuchee Creek, ~4 km WNW of Shannon, GA.	34.35472368	-85.11444083	J. Williams and M. Hughes
8/30/1997	AL	Greene	031601070305	TOM	CR 2 downstream from boat ramp	33.12	-87.92	Dr. David Campbell.
9/2/1997	GA	Floyd	031501050201	C	Coosa River at confluence w/ Oostanaula River	34.25389099	-85.17666626	Williams, J.D.
9/2/1997	GA	Floyd	031501030604	C	Oostanaula River at Coosa River confluence	34.25389099	-85.17666626	Williams, J.D.

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Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
9/2/1997	GA	Floyd	031501030604	C	Oostanaula River at Coosa River confluence	34.25389099	-85.17666626	Williams, J.D.
9/2/1997	GA	Floyd	031501030601	C	Oostanaula River ~2.1 km UPS of the S.R. 140 bridge at the gravel bar.	34.38193663	-85.10443907	J. Williams and M. Hughes
9/2/1997	GA	Floyd	031501030601	C	Oostanaula River Muskrat midden at power line crossing ~2.4 km UPS of the S.R. 140 bridge.	34.3838914	-85.09666643	J. Williams and M. Hughes
9/2/1997	GA	Floyd/ Gordon	031501030601	C	Oostanaula River Big shoal, ~6.4 km UPS of S.R. 140 bridge.	34.4013874	-85.08971577	J. Williams and M. Hughes
9/2/1997	GA	Floyd/ Gordon	031501030601	C	Oostanaula River ~1.0 km DNS of the large island, 7.7 km UPS of S.R> 140 bridge.	34.40416653	-85.10222164	J. Williams and M. Hughes
9/2/1997	GA	Floyd/ Gordon	031501030601	C	Oostanaula River ~8.5 km UPS of the S.R. 140 bridge.	34.41027804	-85.10749944	J. Williams and M. Hughes
9/2/1997	GA	Floyd	031501010504	C	Coosawattee River at confluence w/ Conasauga River	34.543702	-84.902929	Williams, J.D.
9/2/1997	GA	Floyd	031501010504	C	Coosawattee River at confluence w/ Conasauga River	34.543702	-84.902929	Williams, J.D.
9/2/1997	GA	Floyd	031501010504	C	Coosawattee River at confluence w/ Conasauga River	34.543702	-84.902929	Williams, J.D.
9/12/1997	GA	Gordon	031501010504	C	Coosawattee River at confluence w/ Conasauga River	34.54527726	-84.87167189	J. Williams and M. Hughes
9/15/1997	AL	Pickens	031601070305	TOM	Sipsey River 3 mi. W Jena, nr. Co. Hwy. 156	33.12333	-87.90417	McGregor, Stuart W.

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Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
9/22/1997	GA	Murray	031501010211	C	Conasauga River at Tibbs Bridge Rd.	34.736696	-84.857612	M.H. Hughes
9/22/1997	GA	Whitfield	031501010211	C	Conasauga River S.R. 286	34.8269355	-84.85083276	J. Williams and M. Hughes
9/26/1997	GA	Gordon/Floyd	031501030601	C	Oostanaula River Mouth of Muck Creek, ~3.0 km SW of Curryville, GA.	34.422216	-85.09916865	J. Williams and M. Hughes
9/26/1997	GA	Floyd	031501030601	C	Lovejoy Creek 0.5 km u/s of confluence w/ Oostanaula River	34.42412186	-85.1025238	Williams, J.D.
10/8/1997	AL	Dallas	031502011206	AL	30 m from left descending bank Alabama River ARM 209.2	32.3735824	-86.971732	Garner, Jeff.
10/31/1997	AL	Cleburne		TAL	Muscadine Creek, southern rail road crossing off CR 34			Unknown
1997	AL	Cleburne		TAL	Tributaries within Cleburne Co. (Cane Creek, Beach Creek, Muscadine Creek, Dynne Creek)			DeVries, Dennis R.
1997	AL	Cleburne		TAL	Carr Creek at bridge crossing on County Road 17			DeVries, Dennis R.
1997	AL	Cleburne		TAL	Snake Creek at bridge crossing on Alabama Highway 9			DeVries, Dennis R.
5/14/1998	AL	Cleburne		TAL	Somewhere btwn 2 bridge crossings that don't have co. rd. numbers			Unknown
9/1/1998	MS	Itawamba	031601010702	TOM	Bull Mountain Creek 0.2 - 0.5 air miles above Horne's crossing. T10S R9E Sec 25.	34.1818721	-88.3086314	R.L. Jones, T.C. Majure
9/15/1998	AL	Pickens	031601070306	TOM	Sipsey River @ Co. Hwy. 181	33.05444	-88.03833	McGregor, Stuart W.

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Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
9/15/1998	AL	Pickens	031601070305	TOM	Sipsey River @ Alverta Hughes property nr. Mantua	33.07778	-87.96861	McGregor, Stuart W.
9/15/1998	AL	Greene	031601070305	TOM	Sipsey River ~3 mi. west of Jena off Co. Hwy. 156	33.12333	-87.9041666	SWM,PEO
10/11/1998	GA	Bradley	031501010103	C	Conasauga River at Rt. 74	34.990496	-84.77498	Unknown
3/3/1999	AL	Lawrence	031601100101	BW	Flannagin Creek nr. Bankhead National Forest Road 229 (Northwest Road) crossing	34.3388	-87.3884	Unknown
4/3/1999	AL	Lawrence	031601100101	BW	Flannagin Creek nr. Bankhead National Forest Road 229 (Northwest Road) crossing	34.3388	-87.3884	M. Gangloff
5/26/1999	AL	Pickens	031601070306	TOM	Above St. Hwy 14 along left descending side of river Sipsey River	33.0330556	-88.1083333	Garner, Jeff
5/26/1999	AL	Pickens	031601070306	TOM	Above St. Hwy 14 across width of river Sipsey River	33.0336111	-88.105	Garner, Jeff
5/26/1999	AL	Pickens	031601070306	TOM	St. Hwy 14 across width of river Sipsey River	33.0377778	-88.1097222	Garner, Jeff
5/27/1999	AL	Pickens	031601070305	TOM	Sipsey River upstream of cut-off between two islands	33.10889	-87.94222	McGregor, Stuart W
5/27/1999	AL	Greene	031601070305	TOM	Sipsey River upstream of Cotton Bridge (Hwys. 2/156)	33.11222	-87.9394444	SWM,JTG
6/8/1999	AL	Greene	031601070306	TOM	Sipsey River between Hwy. 14 and RR bridge	33.03722	-88.1186111	SWM,JTG,JS

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Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
6/8/1999	AL	Pickens	031601070306	TOM	Sipsey River between AL Hwy. 14 and RR bridge	33.04056	-88.12889	McGregor, Stuart W
6/8/1999	AL	Greene	031601070306	TOM	1 km upstream of B and R Railroad bridge across width of river Sipsey River	33.0372222	-88.1288889	Garner, Jeff
6/13/1999	AL	Cherokee	031501050908	C	Terrapin Creek downstream of County Road 8 crossing, upstream of Hurricane Creek	33.97913401	-85.60188559	Unknown
6/13/1999	AL	Cherokee	031501050908	C	Terrapin Creek ~1km downstream County Road 8 crossing	33.9904	-85.5961	Unknown
6/23/1999	MS	Monroe	031601030604	TOM	Buttahatchee River upstream of Hwy. 373 bridge	33.66500	-88.4563888	SWM, M. Hicks, K. Piggott
7/22/1999	MS	Lowndes	031601050404	TOM	Yellow Creek Sanders Mill Rd. nr. Alabama state line	33.62111	-88.2669444	SWM, TES
7/28/1999	AL	Pickens		AL	Bogue Chitto Creek at Pickens Col route 1, @ 4 air mi. NW of Cochrane			Unknown
8/5/1999	AL	Shelby	031501060808	C	Lower Kelly Study Reach on Kelly Creek between County Road 57 crossing and U. S. Hwy. 231 crossing	33.47873345	-86.40618639	M. Gangloff and J. Feminella
8/22/1999	AL	Cherokee	031501050909	C	Terrapin Creek ~1km upstream of AL Hwy. 9 crossing	34.0479	-85.6048	Unknown
8/25/1999	AL	Shelby	031501060808	C	Lower Kelly Study Reach on Kelly Creek between County Road 57 crossing and U. S. Hwy. 231 crossing	33.47873345	-86.40618639	Unknown

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Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
9/1/1999	GA	Murray/ Whitfield	031501010211	C	Conasauga River River Mile 36.5, ~0.5 km UPS of U.S 76/S.R.52 bridge. ~8.9 km ENE of Dalton, GA.	34.78720088	-84.87458284	P.D. Johnson
9/1/1999	GA	Murray/ Whitfield	031501010211	C	Conasauga River River Mile 39.6, ~0.5 km DNS of the mouth of Mill Creek. ~0.5 km SE of Dawnville, GA.	34.8010464	-84.83806938	P.D. Johnson
9/11/1999	AL	Cherokee	031501050908	C	Terrapin Creek ~1km downstream County Road 8 crossing	33.9904	-85.5961	Unknown
9/18/1999	AL	St. Clair	031501060302	C	Big Canoe Creek nr. County Road 31 crossing	33.8046	-86.4196	Unknown
10/16/1999	AL	Shelby	031501060808	C	Lower Kelly Study Reach on Kelly Creek between County Road 57 crossing and U. S. Hwy. 231 crossing	33.47873345	-86.40618639	Unknown
11/13/1999	AL		031601070305	TOM	Sipsey River, 2 mi. E of Benevola	33.1039869	-87.949964	Paul W. Parmalee
1999	GA	Whitfield/ Murray	031501010211	C	Conasauga River~1.2 km SW of S.R. 286 Bridge, ~2.1 km ESE of Dawnville. GA.	34.820297	-84.856058	R. Evans, P. Johnson
1999	GA	Whitfield/ Murray	031501010211	C	Conasauga River ~670 m SE of Mitchell Bridge, ~2.89 km SE of Dawnville, GA.	34.806461	-84.858692	R. Evans, P. Johnson
1999	GA	Whitfield/ Murray	031501010211	C	Conasauga River ~4.38 km SE of Dawnville, ~7.68 km NW of Chatsworth, GA.	34.805537	-84.852098	R. Evans, P. Johnson
1999	GA	Whitfield/ Murray	031501010204	C	Conasauga River Norton Bridge area, ~570 meters ESE of Norton, GA.	34.85341	-84.84055	R. Evans, P. Johnson

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Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
1999	GA	Whitfield/ Murray	031501010204	C	Conasauga River Norton Bridge area, ~600 meters NW of Norton, GA.	34.85312736	-84.82365091	R. Evans, P. Johnson
1999	GA	Whitfield/ Murray	031501010204	C	Conasauga River ~2.5 km SE of Beaverdale, ~6.0 km NNE of Norton, GA.	34.90366655	-84.82813419	R. Evans, P. Johnson
2/5/2000	AL	Cherokee	031501050909	C	Terrapin Creek nr. AL Hwy. 9 crossing	34.0628	-85.6121	Unknown
5/30/2000	AL	Greene	031601070305	TOM	Near Mantua, off Co. Rd. 183 across width of stream Sipsey River	33.0778403	-87.9682926	Garner, Jeff.
2000	AL	Greene	031601070306	TOM	Sipsey River site 3	33.03333	-88.1	Haag, Wendell R., and Staton, J. L.
2000	AL	Greene	031601070305	TOM	Sipsey River site 1	33.08333	-87.95	Haag, Wendell R., and Staton, J. L.
6/1/2000	AL	Tuscaloosa	031601070301	TOM	US Hwy 82 midstream gravel bar Sipsey River	33.27325	-87.7543956	Garner, Jeff.
6/1/2000	AL	Greene	031601070306	TOM	Co. Rd. 181 across width of stream Sipsey River	33.0542575	-88.0393533	Garner, Jeff.
7/2/2000	AL	Cherokee	031501050909	C	Terrapin Creek downstream of AL Hwy. 9, upstream of County Road 71 crossing	34.06283412	-85.61218568	Unknown
7/24/2000	AL	Cherokee	031501050908	C	Terrapin Creek downstream of County Road 8 crossing, upstream of Hurricane Creek	33.97913401	-85.60188559	Unknown
8/7/2000	AL	Cherokee	031501051003	C	Coosa River Bypass, between the main and re-regulation dams at Weiss Reservoir, 5.28 km below the mouth of Terrapin Creek.	34.12287	-85.7382	Johnson, Paul D

Appendix B contd.

Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
8/7/2000	AL	Cherokee	031501051003	C	Coosa River Bypass, 4.56 km below the mouth of Terrapin Creek (about 700 m upriver from FWS-14).	34.12377	-85.73132	Johnson, Paul D
8/27/2000	AL	Tuscaloosa	031601070301	TOM	Sipsey River Rt 82 Bridge	33.26	-87.75	Dr. David Campbell
9/7/2000	MS	Itawamba	031601010702	TOM	Bull Mountain Creek lowermost shoals, accessed from Smithville via boat	34.09389	-88.3708333	SWM,TES, PEO
9/12/2000	AL	Greene/ Pickens	031601070305	TOM	Sipsey River nr. Greene County Road 156 crossing	33.1031	-87.9504	Unknown
9/21/2000	AL	Tuscaloosa	031601070301	TOM	Sipsey River, immediately downstream of AL Hwy. 82 (bridge 245)	33.2731367	-87.7544808	Paul W. Parmalee
10/9/2000	MS	Lowndes	031601050404	TOM	Yellow Creek above Williams Greer Bridge. T16S R17W Section 36.	33.6267933	-88.2663894	Paul Yokley, M.Putman, R. Huber,K.Behel
10/10/2000	MS	Lowndes	031601050404	TOM	Yellow Creek from Wildcat Road upstream 1-1.5 mi. T17S R17W SECTIONS 1 and 12.	33.6105704	-88.2714983	Paul Yokley, M.Putman,K .Behel,R. Huber
10/11/2000	MS	Lowndes	031601011406	TOM	Tombigbee River 1km upstream of Luxapallila Creek confluence	33.4714241	-88.43972015	Unknown

Appendix B contd.

Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
10/11/2000	MS	Lowndes	031601050405	TOM	Yellow Creek from Wildcat Road downstream 1.5 mi. T17S R17W Section 11	33.5951962	-88.2782452	Paul Yokley, M.Putman, R.Huber,K. Behler
10/12/2000	MS	Lowndes	031601050405	TOM	Yellow Creek between 1.5 and 3 miles below Wildcat Road. T17S R17W Section 15.	33.5804654	-88.3070339	Paul Yokley, M.Putman, R. Huber,K.Behel
10/16/2000	MS	Lowndes	031601050405	TOM	Yellow Creek from mouth upstream from 200 yards above Steens Road bridge. T17S R17W Sec. 21.	33.565643	-88.3219142	Paul Yokley, Michael Putman, Ron Huber
10/17/2000	MS	Lowndes	031601050405	TOM	Yellow Creek from 3 miles below Wildcat Road to 1/2 mile from bridge at Steens. T17S R17W Sec. 15	33.591705	-88.3016752	Paul Yokley, M.Putman, R.Huber, K.Behel
10/18/2000	MS	Lowndes	031601050404	TOM	Yellow Creek from Williams-Greer Road downstream 1 miles. T17S R17W Sec. 1.	33.6130787	-88.2722681	Paul Yokley, M.Putman, R.Huber, K.Behel
10/19/2000	MS	Lowndes	031601011406	TOM	Tombigbee River 1 km upstream of Luxapallilla Creek confluence	33.4714241	-88.43972015	Unknown
10/19/2000	MS	Lowndes	031601050404	TOM	Yellow Crk. from 200 yds above Williams-Greer Rd. 1 mile up right, 500 yds up left fork. T16SR17WS36	33.6315978	-88.2666214	Paul Yokley, M.Putman,K .Behel,R. Huber

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Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
10/23/2000	MS	Lowndes	031601050404	TOM	Yellow Creek from 600-800 yds above Williams- Greer Road. T16S R17W Section 36.	33.624366	-88.2665156	Paul Yokley, M.Putman, R. Huber
2000	AL	Cherokee	031501050908	C	Terrapin Creek (CTR04)	33.98	-85.59	Feminella, Jack W
2000	AL	Cherokee	031501050909	C	Terrapin Creek (CTR03)	34.04	-85.6	Feminella, Jack W
2000	AL	Cherokee	031501050909	C	Terrapin Creek (CTR02)	34.07	-85.63	Feminella, Jack W
2000	AL	Pickens	031601070306	TOM	Sipsey River site 3, upstream from AL Hwy 14	33.0333	-88.1	Haag and Stanton
2000	AL	Greene	031601070305	TOM	Sipsey River site 1, off ML King Hwy	33.08333	-87.95	Haag and Stanton
2000	MS	Monroe	031601030602	TOM	Buttahatchee River near Bartihatchie Road	33.8	-88.3	Haag and Stanton
7/1/2001	AL	Cherokee	031501050908	C	Terrapin Creek ~1km downstream County Road 8 crossing	33.9904	-85.5961	Unknown
7/20/2001	AL	Cherokee	031501050908	C	Terrapin Creek between County Road 8 crossing and AL Hwy. 9 crossing	33.97913406	-85.60188561	Unknown
8/24/2001	AL	Cherokee	031501050908	C	Terrapin Creek downstream of County Road 8 crossing, upstream of Hurricane Creek	33.97913401	-85.60188559	Unknown
8/25/2001	AL	Cherokee	031501050908	C	Terrapin Creek downstream of County Road 8 crossing, upstream of Hurricane Creek			M. Gangloff

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Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
8/282001	AL	Cherokee	031501050909	C	Terrapin Creek ~3km upstream of AL Hwy. 9 crossing (CTR03)	34.0424	-85.592	Unknown
10/6/2001	AL	Cherokee	031501050909	C	Terrapin Creek downstream of AL Hwy. 9, upstream of County Road 71 crossing	34.06283412	-85.61218568	Unknown
10/6/2001	AL	Cherokee	031501050909	C	Terrapin Creek ~2km downstream of AL Hwy. 9 crossing (CTR02)	34.071	-85.6305	Unknown
10/9/2001	AL	Montgom ery	031502010105	AL	Alabama River at Buzzard Island just above Montgomery on east bank. Indian midden.	32.3947843	-86.3238016	Paul Hartfield, J. Garner
2001	AL	Cherokee	031501050908	C	Terrapin Creek (CTR04)	33.98	-85.59	Feminella, Jack W
2001	AL	Cherokee	031501050909	C	Terrapin Creek (CTR03)	34.04	-85.6	Feminella, Jack W
6/21/2002	MS	Lowndes	031601011406	TOM	Tombigbee River 1 km upstream of Luxapallilla Creek confluence	33.4714241	-88.43972015	Unknown
6/21/2002	MS	Lowndes	031601050404	TOM	Yellow Creek unnumbered county road at bridge near Alabama state line	33.62111	-88.2669444	SWM, JTG
7/20/2002	AL	Chambers	031501090304	TAL	Sandy Creek nr. County Road 150 crossing (Jones Mill)	33.0342	-85.5174	Unknown
8/21/2002	MS	Lowndes	031601050404	TOM	Yellow Creek at Williams-Greer Road. T16S R17W Section 36.	33.620784	-88.26712	Jones,Slack, GRuneberg, Kasparian,H unt,SE

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Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
9/10/2002	GA	Floyd	031501030601	C	Oostanaula River Oostanaula River above large powerline (below Horton Bend of river) 2.85 km E of Old Dalton Rd NE	34.39117128	-85.08294676	P.D. Johnson
9/10/2002	GA	Floyd/ Gordon	031501030601	C	Oostanaula River Oostanaula River at Large Shoal below Shipp Island 1.29 km E of Old Dalton Rd NE	34.40313707	-85.09611663	P.D. Johnson
11/10/2002	MS	Lowndes	031601011406	TOM	Old Channel of Tombigbee River at upper end of cutoff at Columbus	33.4868008	-88.4523905	T.C. Major
2002	AL		031501050908	C	Terrapin Creek (CTR04)	33.98	-85.59	Feminella, Jack W
2002	AL		031501050909	C	Terrapin Creek (CTR03)	34.04	-85.6	Feminella, Jack W
2002	AL	Winston	031601100103	TOM	Sipsey Fork near confluence with Hurricane Creek	34.25306	-87.36722	Haag and Warren
2002	AL	Shelby		C	Kelly Creek			Unknown
3/31/2003	AL	Chambers	031501090304	TAL	Sandy Creek nr. County Road 150 crossing (Jones Mill)	33.0342	-85.5174	Unknown
4/22/2003	AL	Tuscaloosa	031601120403	BW	Cedar Creek at its mouth to 120 m upstream	33.579166	-87.622222	Dr Bernie Kuhajda
7/23/2003	AL	Greene	031601060706	TOM	Left descending bank Tombigbee River TRM 235.0	32.6026456	-88.0613784	Garner, Jeff
8/11/2003	AL		031501060810	C	Coosa River mi. 94.52	33.39556	-86.37528	Mettee, Maurice F
8/13/2003	AL	St. Clair	031501060810	C	Coosa River Coosa River mile 95.12, 44.1 miles upstream of Lay Dam	33.40444	-86.3683333	JTG, JBS

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Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
8/14/2003	AL	St. Clair	031501060810	C	30m from right descending bank Coosa River CRM 82.6	33.4069167	-86.3641	Garner, Jeff
8/14/2003	AL	St. Clair	031501060810	C	Coosa River Coosa River mile 95.32, 44.3 miles upstream of Lay Dam	33.40694	-86.3641666	JTG, JBS
8/20/2003	AL	St. Clair/ Talladega	031501060810	C	Coosa River, just downstream of Logan Martin Dam	33.4239	-86.3357	Unknown
8/24/2003	AL	Elmore	031501070907	C	Coosa River from Jordan Dam downstream to AL Hwy. 14 crossing	32.61683254	-86.25658621	Unknown
8/26/2003	AL	Talladega	031501060810	C	Just around bend (downstream) of RR bridge 35 m from left descending bank Coosa River CRM 80.8	33.38115	-86.3673833	Garner, Jeff
8/26/2003	AL	Talladega	031501060810	C	Left descending channel from left descending bank Coosa River CRM 82.0	33.4003167	-86.36935	Garner, Jeff
8/26/2003	AL	Talladega	031501060810	C	Coosa River Coosa River mile 93.52, 42.5 milles upstream of Lay Dam	33.38111	-86.4008333	Garner, Jeff
8/26/2003	AL	Shelby		C	Left descending bank Coosa River CRM 82.4			JTG, Paul Hartfield
8/26/2003	AL	St. Clair	031501060810	C	Coosa River Coosa River mile 94.72, 43.7 miles upstream of Lay Dam	33.38361	-86.3694444	JTG, Paul Hartfield
8/28/2003	AL	Talladega	031501060810	C	25 m from left descending bank Coosa River CRM 81.8	33.39565	-86.3743	Garner, Jeff
8/28/2003	AL	St. Clair	031501060810	C	Coosa River Coosa River mile 94.52, 43.5 miles upstream of Lay Dam	33.39556	-86.3752777	JTG, JBS
9/16/2003	MS	Monroe	031601030603	TOM	Buttahatchee River from Caledonia Bridge upstream. T15S R17W Section 32.	33.715241	-88.3379079	R.Jones, L. Staton

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Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
9/17/2003	MS	Lowndes	031601050404	TOM	Yellow Creek at Williams-Greer Rd. T16S R17W SEC36	33.6267933	-88.2663894	RL Jones, JS Peyton, JL Staton
3/16/2004	AL	Tuscaloosa	031601070301	TOM	Sipsey River just downstream of U. S. Hwy 82 crossing nr. Elrod	33.2727	-87.7548	Unknown
4/23/2004	AL	Jefferson	031502020104	CH	Cahaba River upstream of U.S. Hwy. 78 at Lovick	33.55611	-86.6138888	SWM, Randy Haddock
6/22/2004	AL	Bibb	031502020407	CH	Cahaba River ~1mi. downstream of County Road 24 crossing (Piper Bridge)	33.0852	-87.0644	L. Huff and L. Davis
7/23/2004	AL	Shelby	031502020206	CH	Cahaba River shoal downstream of Savage Creek mouth	33.17111	-87.0127777	SWM, Paul Freeman
8/9/2004	AL	St. Clair	031501060303	C	Co. Rd. 36 across width of stream Big Canoe Creek	33.8326667	-86.28325	Garner, Jeff
8/10/2004	AL	St. Clair	031501060810	C	200 m downstream of 1st island downstream of Kelly Creek 20 m from left descending bank Coosa River	33.3969444	-86.3738889	Garner, Jeff
8/10/2004	AL	Talladega	031501060810	C	1st island downstream of Kelly Creek, secondary channel, approx 1/4 distance downstream from upper end of island	33.402608	-86.367087	Garner, Jeff
8/10/2004	AL	St. Clair	031501060810	C	Approx halfway between Kelly Creek and 1st island downstream 15 m from right descending bank Coosa River	33.4075	-86.3641667	Garner, Jeff
8/10/2004	AL	St. Clair	031501060810	C	Coosa River Logan Martin Dam tailwaters at upper ind (left channel) of Elliott Island	33.40451	-86.367735	JTG, SWM

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Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
8/11/2004	AL	Shelby	031501060810	C	2nd island downstream of Kelly Creek, left descending channel, 100 m downstream of upper end of island	33.3728168	-86.3564281	Garner, Jeff
8/11/2004	AL	Talladega	031501060810	C	2nd island downstream of Kelly Creek (Buzzard Island), left descending channel, adjacent to upper end of island 15 m from left descending bank Coosa River	33.3744444	-86.355	Garner, Jeff
8/12/2004	AL	Shelby	031501060810	C	Coosa River Logan Martin Dam tailwaters at upstream end of second	33.37444	-86.355	JTG, SWM
August 2004	AL	St. Clair		C	Island (Buzzard Island) downstream of Kelley Creek mouth			McGregor, Stuart W. and Jeffrey T. Garner.
9/13/2004	AL	Shelby	031501060810	C	Stations 10-16 (Logan Martin Dam Tailwaters)	33.38611	-86.37722	SWM, Jeffrey Sides
9/14/2004	AL	Shelby	031502020407	CH	Cahaba River at Lily Shoals	33.14889	-87.0377777	McGregor, Stuart W. and Jeffrey T. Garner.
December 2004	AL	Chambers	031502020206	CH	Cahaba River Station 12 - Cahaba River @ south end of Co. Hwy 1	33.20333	-86.97306	M. Gangloff
5/26/2005	AL	Greene	031501090304	TAL	Sandy Creek nr. County Road 150 crossing (Jones Mill)	33.0342	-85.5174	Garner, Jeff
5/26/2005	AL	Greene	031601070305	TOM	Sipsey River, off Greene Co. Rd. 183, near Mantua, across width of river, Drainage: Tombigbee	33.0777	-87.96805	Garner, Jeff

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Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
9/10/2005	AL	Shelby	031601070306	TOM	Sipsey River, Greene Co. Rd. 181, across width of river, Drainage: Tombigbee	33.0540903	-88.0394031	Unknown
9/20/2005	AL	Monroe	031501070205	C	Yellowleaf Creek - Lay Reservoir to 2km downstream of Muddy Prong Cr.	33.311392	-86.494935	R.Jones, S.Peyton, T. Slack
10/16/2005	MS	Cherokee	031601030603	TOM	Buttahatchee River from Caledonia Ramp to 1.5 river miles upstream. T16SR17WS5 to T15SR17WS32.	33.7078117	-88.3427241	M. Gangloff, L. Siefferman, and A. Toomba.
5/6/2006	AL	Chambers	031501050908	C	Terrapin Creek nr. County Road 8	33.9791	-85.6018	M. Gangloff, E. Hartfield
6/22/2006	AL	St. Clair	031501090503	TAL	Sandy Creek at Jones Mill	32.74911	-85.55897	Unknown
8/25/2006	AL	Chambers	031501060305	C	Big Canoe Creek at Oakes Ranch	33.88202	-86.19921	Unknown
8/26/2006	AL	Chambers	031501090503	TAL	Sandy Creek, upstream of Stephens (Jones) Mill Pond	32.74365	-85.54966	Gangloff, Michael M., Emily Hartfield, Brian Helms, David Werneke, Kevin White and Jack W. Feminella.

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Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
8/26/2006	AL	Chambers	031501090503	TAL	Sandy Creek, upstream of Jones Mill	32.74327	-85.54998	M. Gangloff, S. Butler, E. Hartfield, H. Strickland
8/27/2006	AL	Chambers	031501090503	TAL	Sandy Creek, upstream of Stephens (Jones) Mill Pond	32.74365	-85.54966	Gangloff, Hartfield, Butler
8/27/2006	AL	Chambers	031501090503	TAL	Sandy Creek, ~150 m downstream of Jones Mill Rd	32.74911	-85.55897	Gangloff, Michael M., Emily Hartfield, Brian Helms, David Werneke, Kevin White and Jack W. Feminella.
8/29/2006	AL	Chambers	031501090503	TAL	Sandy Creek, at Jones Mill	32.75079	-85.55959	Unknown
8/31/2006	AL	Chambers	031501090501	TAL	Sandy Creek, downstream Chambers County Road 11, ~5 km downstream Jones Mill Dam (Sorrell Farm)	32.79958	-85.57616	Unknown

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Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
9/6/2006	AL	Chambers	031501090501	TAL	Sandy Creek, downstream Chambers County Road 11, ~5 km downstream Jones Mill Dam (Sorrell Farm)	32.79958	-85.57616	Gangloff, Michael M., Emily Hartfield, Brian Helms, David Werneke, Kevin White and Jack W. Feminella
9/14/2006	AL	Chambers	031501090503	TAL	Sandy Creek, downstream of Jones Mill	32.76282	-85.5878	Gangloff, Michael M., Emily Hartfield, Brian Helms, David Werneke, Kevin White and Jack W. Feminella.
December 2006	AL	Chambers	031501090503	TAL	Sandy Creek, downstream of Jones Mill	32.76282	-85.5878	M. Gangloff
2/10/2007	AL	Chambers	031501090304	TAL	Sandy Creek nr. County Road 150 crossing (Jones Mill)	33.0342	-85.5174	Unknown
2/10/2007	AL	Chambers	031501090503	TAL	Sandy Creek at Stephens (Jones) Mill	32.74911	-85.55897	Unknown
2/11/2007	AL	Chambers	031501090503	TAL	Sandy Creek at Stephens (Jones) Mill	33.73761	-85.66032	Unknown

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Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
2/11/2007	AL	Chambers	031501090501	TAL	Sandy Creek, downstream Chambers County Road 11, ~5 km downstream Jones Mill Dam (Sorrell Farm)	32.79958	-85.57616	Gangloff, Hartfield
2/11/2007	AL	Chambers	031501090503	TAL	Sandy Creek, upstream of Jones Mill Pond	32.74365	-85.54966	Gangloff, Hartfield
2/18/2007	AL	Chambers	031501090503	TAL	Sandy Creek, upstream of Stephens (Jones) Mill Pond	32.74365	85.54966	Gangloff, Hartfield, Butler
2/19/2007	AL	Lee	031502010302	TAL	Little Sandy Creek, at Chambers Co. Road 11 bridge	32.79959	-85.54401	M. Gangloff
2/20/2007	AL	Chambers	031501100101	TAL	Little Loblockee Creek at Lee County Road 86 Crossing	32.68493	-85.56126	Unknown
2/25/2007	AL	Chambers	031502010302	TAL	Little Sandy Creek, at Chambers Co. Road 11 bridge	32.79959	-85.54401	Hartfield, Lujan, Ray
4/18/2007	AL	Chambers	031501090503	TAL	Sandy Creek at Jones Mill Dam	32.74911	-85.55897	Unknown
5/26/2007	AL	Chambers	031501090503	TAL	Sandy Creek at Sorrell Property (Jones Mill Downstream Site)	32.762683	-85.587766	Unknown
6/13/2007	AL	Chambers	031501090501	TAL	Sandy Creek, downstream site	32.79958	-85.57616	M. Gangloff

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Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
6/13/2007	AL	Chambers	031501090503	TAL	Sandy Creek at Jones Mill Dam	32.75065	-85.559133	Gangloff, Michael M., Emily Hartfield, Brian Helms, David Werneke, Kevin White and Jack W. Feminella
7/30/2007	AL	Shelby	031501090503	TAL	Sandy Creek, at Jones Mill	32.75079	-85.55959	Gangloff, Godwin
8/25/2007	AL	Chambers	031501070205	C	Yellowleaf Creek 3 km NW Klein, AL Gulf States/Westervelt mitigation bank site	33.31588	-86.49559	M. Gangloff
9/11/2007	AL	Tuscaloosa	031501090503	TAL	Sandy Creek upstream of Stephens Mill Pond	32.74365	-85.54966	Unknown
9/25/2007	AL	Monroe		TOM	Sipsey River			R.Jones, T.Slack, S.Peyton
9/27/2007	MS	Lowndes	031601030603	TOM	Buttahatchee River from Caledonia Ramp upstream 1.5 river miles. T16SR17WS5-T15SR17WS32.	33.7078117	-88.3427241	R.Jones, T.Slack, S.Peyton
10/4/2007	MS	Chambers	031601050404	TOM	Yellow Creek at Williams-Greer Road. T16S R17W Section 36.	33.6267933	-88.2663894	Unknown
10/4/2007	AL	Tallapoosa	031501090503	TAL	Sandy Creek at Sorrell Property (Jones Mill Downstream Site)	32.762417	-85.587056	Unknown
11/112007	AL	Pickens/ Greene	031501090503	TAL	Sandy Creek at Sorrell Property (Jones Mill Downstream Site)	32.762444	-85.593028	Unknown

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Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
6/17/2008	AL	Chambers	031601070305	TOM	Sipsey River nr W. Haag long term monitoring site	33.12138	-87.91046	Gangloff, Michael M., Emily Hartfield, Brian Helms, David Werneke, Kevin White and Jack W. Feminella
9/16/2008	AL	Pickens	031501090503	TAL	Sandy Creek, downstream of Jones Mill	32.76282	-85.5878	J.D. Williams
9/16/2008	AL	Pickens	031601070305	TOM	Sipsey River 0.5 km upstream of Cotton Bridge Rd. crossing	33.1090889	-87.94400787	Garner, Jeff
11/7/2008	AL	Chambers	031601070305	TOM	Sipsey River, upstream of Benevola Bridge, across width of river, Drainage: Tombigbee	33.10369	-87.9502244	M. Gangloff
11/21/2008	AL	Chambers	031501090503	TAL	Sandy Creek near Waverly	32.74485	-85.55604	Unknown
6/9/2009	AL	Gordon	031502010302	TAL	Little Sandy Creek	32.79925	-85.543856	J. Wisniewski
6/29/2009	GA	Tuscaloosa	031501030204	C	Oostanaula River Proposed boat landing ~3.1 km upstream of Reeves Station Road bridge. ~8.0 km WSW of Calhoun, GA.	34.47586407	-85.03040151	M. Gangloff, B. Hamstead, R. Hoch, T. Mosley
7/15/2009	AL	Tuscaloosa	031601070302	TOM	Sipsey River ICP Point 4097	33.218765	-87.785551	Silvano, Amy

Appendix B contd.

Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
7/16/2009	AL	Tuscaloosa	031601070302	TOM	Sipsey Sullivan Forever Wild Tract	33.22038362	-87.7855506	M. Gangloff, B. Hamstead, R. Hoch, T. Mosley
7/17/2009	AL	Tuscaloosa	031601070302	TOM	Sipsey River ICP Point 4086	33.218765	-87.786662	Silvano, Amy
7/18/2009	AL	Tuscaloosa	031601070302	TOM	Sipsey River, Sullivan Forever Wild Tract	33.2115992	-87.79472587	Silvano, Amy
7/18/2009	AL	Tuscaloosa	031601070302	TOM	Sipsey River, Sullivan Forever Wild Tract	33.20337911	-87.80207129	Silvano, Amy
7/19/2009	AL	Tuscaloosa	031601070302	TOM	Sipsey River, Sullivan Forever Wild Tract	33.20399662	-87.79939338	Silvano, Amy
9/1/2009	AL	Monroe	031601070302	TOM	Sipsey River, Sullivan Forever Wild Tract	33.19922985	-87.80844051	Jones,Peyton,Copley,McGregor,Sanderson,Francois
9/3/2009	MS	Lowndes	031601030603	TOM	Buttahatchee River from Caledonia Bridge upstream 1.5 river miles (33.70978, -88.34271).	33.7078117	-88.3427241	Jpnes,Peyton,Sanderson,Francois,Copley,McGregor
11/5/2009	MS	Chambers	031601030604	TOM	Buttahatchee River CA. 1.55 river miles above junction with Tennessee-Tombigbee Waterway. T16S R19W NW4 Section 24 (33.66209, 88.48721).	33.662927	-88.4860159	E. Singer
11/5/2009	AL	Chambers	031501090503	TAL	Sandy Creek at Jones Mill	32.75065	-85.559133	E. Singer
11/6/2009	AL	Chambers	031501090503	TAL	Sandy Creek, usptream Jones Mill dam	32.75079	-85.55959	E. Singer

Appendix B contd.

Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
9/10/2010	AL	Tuscaloosa	031501090503	TAL	Sandy Creek, Sorrell property	32.762683	-85.587766	Gangloff, Michael
9/11/2010	AL	Tuscaloosa	031601070303	TOM	Sipsey River- Lower Forever Wild Tract	33.1778	-87.81681	Gangloff, Michael
9/11/2010	AL	Tuscaloosa	031601070303	TOM		33.16159	-87.8266	Gangloff, Michael
9/24/2010	AL	Tuscaloosa	031601070303	TOM	Sipsey River- Lower Forever Wild Tract	33.16345	-87.82389	Gangloff, Michael
9/24/2010	AL	Tuscaloosa	031601070303	TOM	Sipsey River- Lower Forever Wild Tract	33.15628	-87.83024	Gangloff, Michael
9/25/2010	AL	Tuscaloosa	031601070303	TOM	Sipsey River- Lower Forever Wild Tract	33.16893	-87.81962	Gangloff, Michael
2/23/2011	AL	Chambers	031601070303	TOM	Sipsey River- Lower Forever Wild Tract	33.16893	-87.81962	B. Helms
5/19/2011	AL	Chambers	031501090503	TAL	Sandy Creek at Jones Mill	32.75065	-85.559133	M. Gangloff
May 2011	AL	Chambers	031502010302	TAL	Little Sandy Creek at county road 11 crossing.	32.79958	-85.54397	B. Helms
7/6/2011	AL	Pickens	031501090503	TAL	Sandy Creek, Sorrell property	32.762683	-85.587766	Garner, Jeff
7/6/2011	AL	Pickens	031601070305	TOM	Sipsey River at Co Rd 2 (Romulus Rd) near Benevola 1.34 mi downstream of bridge	33.088783	-87.95816	Garner, Jeff
7/7/2011	AL	Pickens	031601070305	TOM	Sipsey River at Co Rd 2 (Romulus Rd) near Benevola 1.12 mi downstream of bridge	33.0913	-87.9576	Garner, Jeff

Appendix B contd.

Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
7/7/2011	AL	Pickens	031601070305	TOM	Sipsey River at Co Rd 2 (Romulus Rd) near Benevola 1.50 mi downstream of bridge	33.08695	-87.966216	Garner, Jeff
7/7/2011	AL	Pickens	031601070305	TOM	Sipsey River at Co Rd 2 (Romulus Rd) near Benevola 1.59 mi downstream of bridge	33.0873	-87.959083	Garner, Jeff
7/7/2011	AL	Pickens	031601070305	TOM	Sipsey River at Co Rd 2 (Romulus Rd) near Benevola 1.41 mi downstream of bridge	33.08813	-87.95725	Garner, Jeff
9/7/2011	AL	Chambers	031601070305	TOM	Sipsey River at Co Rd 2 (Romulus Rd) near Benevola 0.58 mi upstream of bridge	33.109	-87.944	Unknown
4/11/2012	GA	Haralson	031501080103	TAL	Tallapoosa River at Copper mine rd. WPT 215	33.854963	-85.08591	G. Dinkins
4/12/2012	GA	Haralson	031501080203	TAL	Beach Creek SR 120 UPS to confluence with Bush Ck. ~8.4 km NW of Bremen.	33.76304447	-85.22291621	G. Dinkins
4/19/2012	GA	Haralson	031501080203	TAL	Bush Creek From Bremen Reservoir DNS to confluence with Beach Creek. ~5.7 km NW of Bremen.	33.74154619	-85.20317044	G. Dinkins
4/19/2012	GA	Haralson	031501080203	TAL	Bush Creek between Bremen Reservoir and Beach Creek	33.74437	-85.21326	G. Dinkins
4/25/2012	GA	Haralson	031501080205	TAL	Little Creek Broad Street to ~ 400 meters UPS of Broad Street. ~5.3 km NW of Tallapoosa.	33.76903467	-85.33910498	G. Dinkins
4/25/2012	GA	Haralson	031501080205	TAL	Little Creek Jacksonville Road to DNS ~1.2 km of Jacksonville Road. ~5.5 km NW of Tallapoosa.	33.78507983	-85.33374394	G. Dinkins

Appendix B contd.

Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
4/25/2012	GA	Haralson	031501080201	TAL	Little Creek at Southern Pipeline	33.87835	-85.32317	G. Dinkins
4/26/2012	GA	Cherokee	031501080205	TAL	Little Creek downstream Jacksonville Road	33.78533	-85.33366	Garner, Jeff
9/6/2012	AL	Cherokee	031501050908	C	Terrapin Creek	33.9956833	-85.5967	Garner, Jeff
9/6/2012	AL	Cherokee	031501050908	C	Terrapin Creek	34.0079	-85.5887036	Garner, Jeff
9/6/2012	AL		031501050909	C	Terrapin Creek	34.02215	-85.5751666	
9/6/2012	AL	Chambers		C	Terrapin Creek around long island just above Hurricane Creek confluence	34 00.474	85 35.322	
9/9/2013	AL	Chambers			WPT 221			M. Gangloff, R. Kessler, J. Holcomb
3/15/2013	AL	Cleburne	031502010302	TAL	Chambers County Road 11 crossing	32.799252	-85.543863	M. Gangloff, M. Perkins, J. Holcomb
8/30/2013	AL	Lamar	031501080303	TAL	County Road 49 crossing	33.77422	-85.41458	M.Gangloff
9/1/2013	AL	Lamar	031601030101	TOM	West Fork Buttahatchee at AL Hwy 129	34.128055	-87.737569	M.Gangloff

Appendix B contd.

Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
9/1/2013	AL	Lamar	031601030101	TOM	West Fork Buttahatchee at CR48	34.184839	-87.715448	M.Gangloff
9/1/2013	AL	Monroe	031601030102	TOM	Buttahatchee River at AL Hwy 129	34.112524	-87.73129	M.Gangloff
5/26/2014	MS	Monroe	031601030604	TOM	Buttahatchee River just upstream from MS 373 crossing	33.67002	-88.4508	M.Gangloff
5/27/2014	MS	Monroe	031601030602	TOM	Buttahatchee River, shoal at upper WL MS property access	33.8437	-88.31088	M.Gangloff
5/27/2014	MS	Monroe	031601030603	TOM	Buttahatchee River, shoal upstream from Rye Bottom Road crossing	33.75695	-88.32107	M.Gangloff
7/16/2014	MS	Monroe	031601030604	TOM	Buttahatchee River, downstream of MS 373	33.66551	-88.46282	M.Gangloff
7/17/2014	MS	Monroe	031601030603	TOM	Buttahatchee River, first shoal upstream of Caledonia Road	33.70746	-88.34407	M.Gangloff
7/17/2014	MS	Monroe	031601030603	TOM	Buttahatchee River, shoal just downstream from Bartahatchie Bridge	33.78864	-88.3157	M.Gangloff
8/1/2014	MS	Monroe	031601030604	TOM	Buttahatchee River, shoal upstream of RR Bridge, downstream of power line break	33.67131	-88.41548	M.Gangloff
8/1/2014	MS	Monroe	031601030604	TOM	Buttahatchee River, first shoal upstream from US 45	33.67484	-88.42722	M.Gangloff
8/3/2014	MS	Monroe	031601030602	TOM	Buttahatchee River, 0.5 km upstream from Bartahatchie Road	33.79352	-88.31192	M.Gangloff
8/3/2014	MS	Monroe	031601030602	TOM	Buttahatchee River 2 km upstream from Bartahatchie Road	33.79924	-88.30944	M.Gangloff

Appendix B contd.

Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
8/4/2014	MS	Monroe	031601030602	TOM	Buttahatchee River , upstream from Bartahatchie just above power/gas line crossing	33.80827	-88.31005	M.Gangloff
8/5/2014	MS	Monroe	031601030306	TOM	Buttahatchee River upstream from Gattman Bottom Rd., MS launch	33.894807	-88.230018	M.Gangloff
8/6/2014	MS	Monroe	031601030603	TOM	Buttahatchee River first shoal upstream old Rye Bottom Road bridge	33.74554	-88.31902	M.Gangloff
8/6/2014	MS	Monroe	031601030603	TOM	Buttahatchee River third shoal upstream old Rye Bottom Road crossing	33.74958	-88.32146	M.Gangloff
9/2/2014	MS	Monroe	031601030602	TOM	Buttahatchee River, B120	33.88231	-88.28917	M.Gangloff
9/3/2014	MS	Monroe	031601030601	TOM	Buttahatchee River between RR Bridge and 278 nr Bend.	33.885702	-88.288322	M.Gangloff
9/3/2014	MS	Monroe	031601030601	TOM	Buttahatchee River shoal complex 200 m downstream of RR Bridge crossing	33.88617486	-88.28417292	M.Gangloff
9/3/2014	MS	Monroe	031601030604	TOM	Buttahatchee River shoal uptream of Caledonia Rd.	33.688556	-88.366178	M.Gangloff
9/4/2014	MS	Monroe	031601030604	TOM	Buttahatchee River shoal complex upstream of TTW confluence	33.66642219	-88.47455977	M.Gangloff
9/4/2014	MS	Monroe	031601030604	TOM	Buttahatchee River shoal complex upstream of TTW confluence	33.6676775	-88.47395938	M.Gangloff
9/4/2014	MS	Lamar	031601030604	TOM	Buttahatchee River, B015	33.669412	-88.440929	M.Gangloff

Appendix B contd.

Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
9/5/2014	AL	Lamar	031601030303	TOM	Buttahatchee River at Fulton Bridge (d/s 78 crossing)	34.090989	-88.012949	M.Gangloff
9/5/2014	AL	Lamar	031601030304	TOM	Buttahatchee River at CR16	34.015676	-88.054278	M.Gangloff
9/5/2014	AL	Lamar	031601030306	TOM	Buttahatchee on WL MS Land	33.89816	-88.18941	M.Gangloff
9/5/2014	AL	Lamar	031601030306	TOM	Buttahatchee at AL 17	33.918483	-88.147517	M.Gangloff
9/5/2014	AL	Lamar	031601030601	BW	Sipsey Creek at Sipsey Trail Road	33.91742	-88.27081	M.Gangloff
9/5/2014	AL	Lamar	031601030601	BW	Sipsey Creek at Sipsey Fork Road	33.94923	-88.25464	M.Gangloff
11/2/2015	AL	Winston	031601030102	TOM	Buttahatchee River, downstream from Lake Buttahatchee	34.112688	-87.714897	M. Gangloff
9/4/2015	AL	Haralson	031601100103	BW	Sipsey Fork at RKM 29 Qualitative Mussel Survey	34.250922	-87.366978	G. Pandolfi, J. Isenhower, S. Geda
9/10/2015	GA	Haralson	031501080202	TAL	Tallapoosa River at Poplar Springs Rd.	33.81359	-85.27599	G. Pandolfi, J. Isenhower, S. Geda
9/10/2015	GA	Haralson	031501080202	TAL	Tallapoosa River at Poplar Springs Rd.	33.81359	-85.27599	G. Pandolfi, J. Isenhower, S. Geda

Appendix B contd.

Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
9/10/2015	GA	Haralson	031501080203	TAL	Beech Creek at 120	33.76286	-85.22389	G. Pandolfi, J. Isenhower, S. Geda
9/11/2015	GA	Haralson	031501080104	TAL	Tallapoosa River at Mountain View Rd	33.86211	-85.14854	G. Pandolfi, J. Isenhower, S. Geda
9/11/2015	GA	Cleburne	031501080104	TAL	Tallapoosa River at Mount Zion East Rd.	33.86428	-85.16457	G. Pandolfi, J. Isenhower, S. Geda
9/12/2015	AL	Pickens	031501080403	TAL	Cane Creek at CR29	33.65948	-85.51637	Paul Johnson
9/16/2015	AL	Greene	031601060408	TOM	Lubbub Creek, County Rd. 24	33.15549	-88.10417	Paul Johnson
9/28/2015	AL	Sumter		TOM	Sipsey River west of Jena	33.121667	-87.911117	van der Schalie
1933, 1935	AL	Floyd		TOM	Tombigbee River upstream of Epes RR bridge	32.696841	-88.116126	J.C. Hurd
1970s	GA	Bartow		C	Coosa River at Rome	34.246938	-85.192674	J.C. Hurd
1970s	GA	Gordon		C	Etowah River 2.1 mi WSW of Kingston	34.221623	-84.981186	J.C. Hurd
1970s	GA	Whitfield		C	Conasauga River, Fikes Ford, 1.3 mi NNE of Resaca	34.60296	-84.94011	J.C. Hurd
1970s	GA	Murray		C	Conasauga River, Tilton	34.667393	-84.929639	J.C. Hurd
1970s	GA	Whitfield		C	Conasauga River, Tibb's Bridge 2.7 mi SW of Spring Place	34.736696	-84.857612	J.C. Hurd
1970s	GA	Whitfield		C	Coahulla Creek 3.2 mi SSW of Dawnville	34.775513	-84.897572	J.C. Hurd

Appendix B contd.

Date	State	County	HUC 12	Drainage	Locality	Latitude	Longitude	Collectors
1970s	GA	Murray		C	Coahulla Creek 5.0 mi WSW of Beaverdale	34.892563	-84.924806	J.C. Hurd
1970s	GA	Murray		C	Conasauga River, Campbell's Mill and Gregory's Mill, 3.4 mi SW of Tennga	34.953667	-84.785424	J.C. Hurd
1970s	GA	Polk		C	Conasauga River, Tractor Ford, 2.2 mi WSW of Tennga	34.968075	-84.785027	J.C. Hurd
1970s	GA	Greene		C	Conasauga River, Howard Mill Ford and Twin Island Ford, 0.5 mi N of Conasauga	35.010769	-84.729135	J. Williams et al.
1972-1975	AL	Talladega		TOM	Tombigbee River	32.847718	-88.157508	P.Hartfield R. Jones
1991-1993, 1996	AL	Lowndes	031601120403	BW	Cedar Creek near Confluence with North River	33.582914	-87.621171	P.Hartfield, D.Miller

Appendix C. Microsatellite allelic data and metadata for individuals genotyped at 5 loci developed by Ward et al. (2010).

Individual	Drainage	Site	Lat.	Long.	Eco 29		Eco 21		Eco 2		Eco 1		Eco 23	
9.7.16.1.1	Tom	Buttahatchee River 140m u/s of Lawrence Bridge Rd.	33.703903	-88.34601	212	212	274	278	243	243	208	208	230	232
9.7.16.1.2	Tom	Buttahatchee River 140m u/s of Lawrence Bridge Rd.	33.703903	-88.34601	212	212	274	276	243	243	208	212	232	244
9.7.16.1.3	Tom	Buttahatchee River 140m u/s of Lawrence Bridge Rd.	33.703903	-88.34601	212	212	274	276	243	243	208	212	232	232
9.7.16.1.4	Tom	Buttahatchee River 140m u/s of Lawrence Bridge Rd.	33.703903	-88.34601	212	212	276	276	243	243	208	208	232	238
9.7.16.1.5	Tom	Buttahatchee River 140m u/s of Lawrence Bridge Rd.	33.703903	-88.34601	212	212	252	272	243	243	212	212	232	232
9.7.16.2.2	Tom	Buttahatchee River 140m u/s of Lawrence Bridge Rd.	33.703903	-88.34601	212	212	272	276	243	245	208	208	226	232
9.8.16.1.1	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	262	268	243	245	208	212	234	240
9.8.16.1.12	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	272	278	243	245	212	212	232	234
9.8.16.1.2	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	268	274	243	243	208	212	232	242
9.8.16.1.5	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	264	270	243	245	212	212	232	232
9.8.16.1.6	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	276	282	243	243	208	208	232	238
9.8.16.1.7	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	276	282	243	243	208	208	238	238
9.8.16.1.8	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	274	282	243	243	212	212	230	238
9.8.16.1.9	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	272	276	243	243	206	208	232	238
9.8.16.2.1	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	260	274	243	243	208	212	232	238
9.8.16.2.10	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	262	282	243	243	208	212	238	238

Appendix C contd.

Individual	Drainage	Site	Lat.	Long.	Eco 29		Eco 21		Eco 2		Eco 1		Eco 23	
9.8.16.2.11	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	274	278	243	243	212	212	232	238
9.8.16.2.13	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	264	272	243	243	212	212	234	238
9.8.16.2.14	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	268	276	243	243	212	212	232	234
9.8.16.2.15	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	268	274	243	243	208	212	234	238
9.8.16.2.16	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	274	278	245	245	208	212	232	232
9.8.16.2.17	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	260	278	243	245	208	208	0	0
9.8.16.2.18	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	266	274	243	243	212	212	0	0
9.8.16.2.19	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	272	278	243	243	212	212	232	238
9.8.16.2.2	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	274	276	243	243	208	212	232	238
9.8.16.2.20	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	258	276	243	245	212	212	234	238
9.8.16.2.21	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	260	274	0	0	208	208	232	234
9.8.16.2.22	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	260	274	243	243	212	212	232	238
9.8.16.2.3	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	272	278	243	243	212	254	232	238
9.8.16.2.4	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	272	276	243	245	212	212	238	242
9.8.16.2.5	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	260	266	243	243	208	212	232	232
9.8.16.2.6	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	258	272	243	245	212	212	238	242
9.8.16.2.7	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	274	276	243	243	212	212	238	238

Appendix C contd.

Individual	Drainage	Site	Lat.	Long.	Eco 29		Eco 21		Eco 2		Eco 1		Eco 23	
9.8.16.2.8	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	268	274	243	243	212	212	232	240
9.7.16.1.1	Tom	Buttahatchee River 140m u/s of Lawrence Bridge Rd.	33.703903	-88.34601	212	212	274	278	243	243	208	208	230	232
9.7.16.1.2	Tom	Buttahatchee River 140m u/s of Lawrence Bridge Rd.	33.703903	-88.34601	212	212	274	276	243	243	208	212	232	244
9.7.16.1.3	Tom	Buttahatchee River 140m u/s of Lawrence Bridge Rd.	33.703903	-88.34601	212	212	274	276	243	243	208	212	232	232
9.7.16.1.4	Tom	Buttahatchee River 140m u/s of Lawrence Bridge Rd.	33.703903	-88.34601	212	212	276	276	243	243	208	208	232	238
9.7.16.1.5	Tom	Buttahatchee River 140m u/s of Lawrence Bridge Rd.	33.703903	-88.34601	212	212	252	272	243	243	212	212	232	232
9.7.16.2.2	Tom	Buttahatchee River 140m u/s of Lawrence Bridge Rd.	33.703903	-88.34601	212	212	272	276	243	245	208	208	226	232
9.8.16.1.1	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	262	268	243	245	208	212	234	240
9.8.16.1.12	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	272	278	243	245	212	212	232	234
9.8.16.1.2	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	268	274	243	243	208	212	232	242
9.8.16.1.5	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	264	270	243	245	212	212	232	232
9.8.16.1.6	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	276	282	243	243	208	208	232	238
9.8.16.1.7	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	276	282	243	243	208	208	238	238
9.8.16.1.8	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	274	282	243	243	212	212	230	238
9.8.16.1.9	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	272	276	243	243	206	208	232	238

Appendix C contd.

Individual	Drainage	Site	Lat.	Long.	Eco 29		Eco 21		Eco 2		Eco 1		Eco 23	
9.8.16.1.8	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	274	282	243	243	212	212	230	238
9.8.16.1.9	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	272	276	243	243	206	208	232	238
9.8.16.2.1	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	260	274	243	243	208	212	232	238
9.8.16.2.10	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	262	282	243	243	208	212	238	238
9.8.16.2.11	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	274	278	243	243	212	212	232	238
9.8.16.2.13	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	264	272	243	243	212	212	234	238
9.8.16.2.14	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	268	276	243	243	212	212	232	234
9.8.16.2.15	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	268	274	243	243	208	212	234	238
9.8.16.2.16	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	274	278	245	245	208	212	232	232
9.8.16.2.17	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	260	278	243	245	208	208	0	0
9.8.16.2.18	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	266	274	243	243	212	212	0	0
9.8.16.2.19	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	272	278	243	243	212	212	232	238
9.8.16.2.2	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	274	276	243	243	208	212	232	238
9.8.16.2.20	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	258	276	243	245	212	212	234	238
9.8.16.2.21	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	260	274	0	0	208	208	232	234
9.8.16.2.22	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	260	274	243	243	212	212	232	238

Appendix C contd.

Individual	Drainage	Site	Lat.	Long.	Eco 29		Eco 21		Eco 2		Eco 1		Eco 23	
9.8.16.2.3	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	272	278	243	243	212	254	232	238
9.8.16.2.4	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	272	276	243	245	212	212	238	242
9.8.16.2.5	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	260	266	243	243	208	212	232	232
9.8.16.2.6	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	258	272	243	245	212	212	238	242
9.8.16.2.7	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	274	276	243	243	212	212	238	238
9.8.16.2.8	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	268	274	243	243	212	212	232	240
9.8.16.2.9	Tom	Buttahatchee River 467m u/s Bartahatchie Rd. crossing	33.79646	-88.31074	212	212	264	270	243	243	208	208	234	238
6.17.16.1.1	Tall	Little Sandy Crk. ~20m u/s CR 11 bridge	32.79929	-85.54351	0	0	244	248	225	225	194	224	230	236
6.17.16.1.2	Tall	Little Sandy Crk.~20m u/s CR 11 bridge	32.79929	-85.54351	218	218	246	254	225	225	216	224	230	230
6.17.16.1.3	Tall	L. Sandy Crk. ~20m u/s CR 11 bridge	32.79929	-85.54351	218	218	244	248	225	225	226	228	228	228
6.17.16.1.4	Tall	L. Sandy Crk. ~20m u/s CR 11 bridge	32.79929	-85.54351	218	218	244	252	225	225	216	224	228	246
6.17.16.1.6	Tall	L. Sandy Crk.	32.79929	-85.54351	0	0	250	252	225	225	216	216	228	238
6.17.16.1.7	Tall	L. Sandy Crk.~20m u/s CR 11 bridge	32.79929	-85.54351	218	218	242	254	225	225	222	224	230	236
6.17.16.1.8	Tall	L. Sandy Crk. ~20m u/s CR 11 bridge	32.79929	-85.54351	218	218	242	248	225	225	226	226	0	0
6.17.16.2.1	Tall	Sandy Creek ~50m u/s from CR 11	32.75056	-85.55898	218	218	242	244	225	225	224	228	222	230
6.17.16.2.2	Tall	Sandy Creek ~50m u/s from CR 11	32.75056	-85.55898	218	218	242	244	225	225	218	222	224	228
6.17.16.2.3	Tall	Sandy Creek ~50m u/s from CR 11	32.75056	-85.55898	218	220	242	244	225	225	218	226	228	236
6.17.16.2.4	Tall	Sandy Creek ~50m u/s from CR 11	32.75056	-85.55898	218	218	242	256	225	225	216	226	0	0
6.17.16.2.6	Tall	Sandy Creek ~50m u/s from CR 11	32.75056	-85.55898	218	218	248	258	225	225	216	218	242	244
6.17.16.2.7	Tall	Sandy Creek ~50m u/s from CR 11	32.75056	-85.55898	0	0	242	242	225	225	224	226	230	244

Appendix C contd.

Individual	Drainage	Site	Lat.	Long.	Eco 29		Eco 21		Eco 2		Eco 1		Eco 23	
6.17.16.3.1	Tall	Sandy Creek ~50m u/s from CR 11	32.75056	-85.55898	218	218	242	242	225	225	218	222	230	238
6.19.16.1.2	Tall	Sandy Crk. at Jones Mill Dam	32.75056	-85.55898	218	218	242	242	219	225	224	224	230	244
6.19.16.1.3	Tall	Sandy Crk. at Jones Mill Dam	32.75056	-85.55898	218	218	242	248	225	225	216	226	0	0
6.19.16.1.4	Tall	Sandy Crk. at Jones Mill Dam	32.75056	-85.55898	0	0	242	256	225	225	224	224	224	236
6.19.16.1.5	Tall	Sandy Crk. at Jones Mill Dam	32.75056	-85.55898	218	218	244	256	225	225	0	0	230	230
6.19.16.1.7	Tall	Sandy Crk. at Jones Mill Dam	32.75056	-85.55898	218	218	242	258	225	225	214	218	228	230
6.19.16.2.1	Tall	Sandy Crk. at Jones Mill Dam	32.75056	-85.55898	0	0	242	244	225	225	218	222	228	230
7.10.16.1.10	Tom	Sipsey River on Weyerheuser property	33.12156	-87.91098	212	214	274	278	243	243	206	208	226	234
7.10.16.1.11	Tom	Sipsey River on Weyerheuser property	33.12156	-87.91098	212	214	272	276	243	243	208	212	226	228
7.10.16.1.12	Tom	Sipsey River on Weyerheuser property	33.12156	-87.91098	212	214	266	272	243	243	206	214	226	234
7.10.16.1.13	Tom	Sipsey River on Weyerheuser property	33.12156	-87.91098	212	212	280	290	243	243	208	208	226	228
7.10.16.1.14	Tom	Sipsey River on Weyerheuser property	33.12156	-87.91098	212	214	260	268	243	243	208	212	232	232
7.10.16.1.15	Tom	Sipsey River on Weyerheuser property	33.12156	-87.91098	212	212	276	284	243	243	208	208	226	228
7.10.16.1.3	Tom	Sipsey River on Weyerheuser property	33.12156	-87.91098	204	212	262	276	243	243	0	0	226	228
7.10.16.1.4	Tom	Sipsey River on Weyerheuser property	33.12156	-87.91098	212	214	276	286	243	243	206	208	226	226
7.10.16.1.5	Tom	Sipsey River on Weyerheuser property	33.12156	-87.91098	212	214	258	260	243	243	208	208	226	226
7.10.16.1.6	Tom	Sipsey River on Weyerheuser property	33.12156	-87.91098	212	214	268	272	243	243	208	208	226	226
7.10.16.1.9	Tom	Sipsey River on Weyerheuser property	33.12156	-87.91098	212	214	276	284	243	243	208	214	226	226
7.10.16.2.16	Tom	Sipsey River site 5	33.041	-88.035	212	212	286	292	243	243	206	208	226	230
7.10.16.2.17	Tom	Sipsey River Mike and Trish property	33.041	-88.035	212	212	260	278	243	243	206	206	232	232
7.10.16.2.18	Tom	Sipsey River Mike and Trish property	33.041	-88.035	212	212	266	292	243	243	208	214	226	232

Appendix C contd.

Individual	Drainage	Site	Lat.	Long.	Eco 29		Eco 21		Eco 2		Eco 1		Eco 23	
7.10.16.2.19	Tom	Sipsey River Mike and Trish property	33.041	-88.035	212	212	278	290	243	243	208	208	230	236
7.10.16.2.20	Tom	Sipsey River Mike and Trish property	33.041	-88.035	212	212	260	294	243	243	208	210	226	226
10.29.16.1.10	Tom	Sipsey River lower Forever Wild Tract	33.23177	-87.77766	212	214	258	262	243	243	210	210	230	232
10.29.16.1.2	Tom	Sipsey River lower Forever Wild Tract	33.23177	-87.77766	212	212	262	274	243	243	206	208	226	226
10.29.16.1.3	Tom	Sipsey River lower Forever Wild Tract	33.23177	-87.77766	212	212	264	286	243	243	206	208	226	226
10.29.16.1.6	Tom	Sipsey River lower Forever Wild Tract	33.23177	-87.77766	0	0	278	284	243	243	206	208	228	232
10.29.16.1.7	Tom	Sipsey River lower Forever Wild Tract	33.23177	-87.77766	212	214	260	274	243	243	208	208	230	230
10.29.16.1.8	Tom	Sipsey River lower Forever Wild Tract	33.23177	-87.77766	212	214	264	288	243	243	206	208	226	228
10.29.16.1.9	Tom	Sipsey River lower Forever Wild Tract	33.23177	-87.77766	212	214	0	0	243	243	206	208	226	228
5.16.16.3.1	Tall	Tallapoosa River at Poplar Springs Rd.	33.81422	-85.27589	218	218	242	242	225	225	0	0	224	240
5.16.16.3.13	Tall	Tallapoosa River at Poplar Springs Rd.	33.81422	-85.27589	218	218	242	242	225	225	236	238	220	230
5.16.16.3.16	Tall	Tallapoosa River at Poplar Springs Rd.	33.81422	-85.27589	218	218	242	244	225	225	0	0	224	224
5.16.16.3.17	Tall	Tallapoosa River at Poplar Springs Rd.	33.81422	-85.27589	218	218	242	246	225	225	0	0	220	224
5.16.16.3.18	Tall	Tallapoosa River at Poplar Springs Rd.	33.81422	-85.27589	218	218	244	246	225	225	240	242	0	0
5.16.16.3.20	Tall	Tallapoosa River at Poplar Springs Rd.	33.81422	-85.27589	218	218	242	242	225	225	208	208	0	0
5.16.16.3.3	Tall	Tallapoosa River at Poplar Springs Rd.	33.81422	-85.27589	218	218	242	246	225	225	242	242	0	0

Appendix C contd.

Individual	Drainage	Site	Lat.	Long.	Eco 29		Eco 21		Eco 2		Eco 1		Eco 23	
5.16.16.3.8	Tall	Tallapoosa River at Poplar Springs Rd.	33.81422	-85.27589	0	0	240	242	225	225	226	230	220	234

Vita

Daniel H. Mason was born in Raleigh, NC to David and Denise Mason in June 1992. He spent much of his time as a youngster playing in creeks, and as an undergraduate at Appalachian State, discovered that he enjoyed it just as much an adult. He graduated from Appalachian State with a Bachelor's of Science degree in 2014 and subsequently began his Master's degree, which he completed in 2017. During his time as a student and research technician he assisted with scientific projects related to the ecology, conservation and evolution of birds, crayfish, fish, terrestrial and giant salamanders and freshwater mussels, in addition to his Master's thesis research.